JUN 19 1928

INSTRUMENTS

INDUSTRIAL — SCIENTIFIC

devoted to the Instrument Problems of all Industries

Vol. 1. No. 2 Pittsburgh, Pa. February, 1928

IN THIS ISSUE

Instrument Pioneers—Alessandro Volta (1745-1827)

Comparison of the Various Methods of Testing the Hardness of Metals.
D. L. MATHIAS, PITTSBURGH, PA.

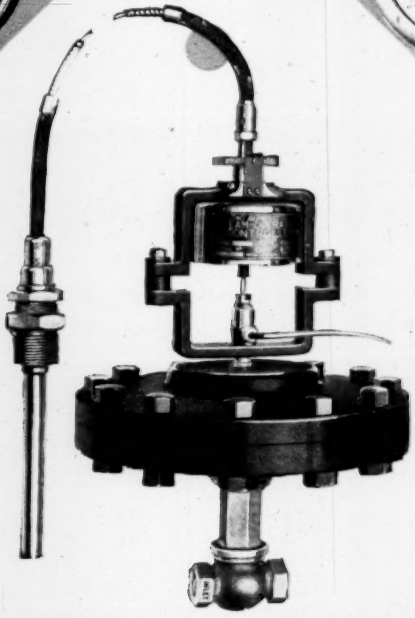
Instruments for the Measurement of Electrical Insulation.
A. WATSON, PITTSBURGH, PA.

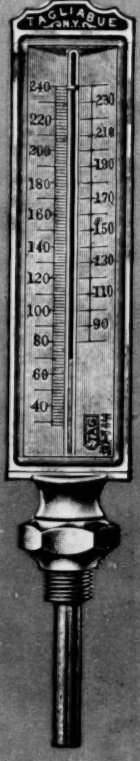
Measuring to Four Parts in a Billion.
P. P. CIOFFI, NEW YORK, N. Y.

The New Improved Type of Brady B.T.U. Indicator.
R. A. MALONY, PHILADELPHIA, PA.

The Measurement of Luster.
DR. W. EWALD, BERLIN, GERMANY

Place initials of interested persons in your organization opposite title and call it to their attention.





Now, for the first time

Steam Controls Itself With Its Own Power

Automatic temperature or pressure control has been obtained up to now in only two ways—by self-operating devices and by controllers utilizing auxiliary power such as compressed air. Readers of "INSTRUMENTS" know that the former are inexpensive and convenient *but* weak and sluggish, and the latter quick-acting, powerful and accurate *but* sometimes costly.

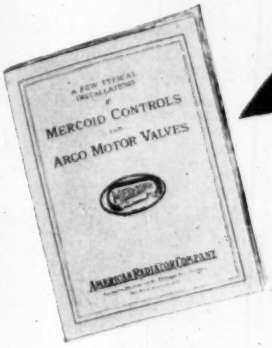
Now comes the TAG *Steam-Operated Controller* —combining all "air-op" advantages with "self-op" convenience and low cost . . . . A strong statement? Yes, but based on performance.

Write for Catalog I-950

C. J. TAGLIABUE MFG. CO.

18 to 88 Thirty Third St., Brooklyn, N.Y.

This Book



reveals the Amazing Adaptability of MERCOID Controls

for Industrial Purposes

Send for YOUR *Copy*

NO engineer, no technically trained man, is too busy to contribute to development in his particular field or any production phase or operation therein.

Because of this, we are asking the engineering and technical men of American Industry to send for this book and to make a little study of MERCOID Automatic Controls in connection specifically with their control problems.

We are frank to say that it was the technical men of American Industry who awakened us several years ago to the potentialities of this little instrument, and prompted the research, experimentation and development work which has since made MERCOID so successful and so indispensable in almost every manufacturing industry.

MERCOID, years ago, proved its dependability and accuracy in the heating industry. Today—thanks to the Engineering and Technical Executives of American Industry, it is proving just as dependable, just as positive and accurate, and infinitely more invaluable, in the control of temperature, pressure and vacuum for innumerable industrial practices and processes. We feel, therefore, that it is essential that you send for this book. It is free. *Just clip the coupon, fill it in, and send it to us.*

American Radiator Co.
Chicago, Ill.

Send me free illustrated literature on MERCOID Controls.

Name .....

Street .....

City ..... "R"

AMERICAN RADIATOR COMPANY

ACCESSORIES DIVISION
816-820 South Michigan Avenue
Chicago, Illinois

If you are interested in industrial instruments for measuring, checking or controlling various operations in the industries, you should be a subscriber and reader of

INSTRUMENTS

INDUSTRIAL—SCIENTIFIC

a monthly publication devoted to the instrument problems of all industries.

Subscription - - - $2.00 per year

A JOURNAL WORTH READING

A JOURNAL YOU WILL APPRECIATE

Our Guaranteed Distribution of 10,000 copies monthly

is on the rotary plan. 45,000 plants are represented on our mailing list to date. Each issue, 10,000 copies will be sent to subscribers and others. The later will be chosen from our list. If you do not subscribe you will not receive the next issue and every issue contains important instrument information which you should not miss. Two Dollars for a year's subscription guarantees your receiving every issue for one year. Any article appearing in a single issue is well worth the price of the subscription. Mail TWO DOLLARS to-day and have your name placed upon our every issue list of paid subscribers. It will be two dollars well invested.

ARTICLES BY AN EXPERIENCED EDITORIAL STAFF AND COLLABORATORS WITH WIDE EXPERIENCE AND TECHNICAL KNOWLEDGE

INSTRUMENTS PUBLISHING CO.

1117 WOLFENDALE ST. PITTSBURGH, PA.

For Safety and Economy, specify

POWELL VALVES

Fig. 102
Bronze "White Star" Globe Valve

Standard in quality, distinctive in design, finest of workmanship, and truly finished products, thoroughly inspected and rigidly tested with more than eighty years of continuous development for longevity and economy in service.

Bronze, iron and steel globe, angle, cross, check and gate valves—a valve for every purpose—as well as whistles, oil and water gauges, fusible plugs, and a most complete line of engineering appliances comprise the Powell Line.

Expert advice can be had by applying to our Engineers who can give you the benefit of years of practical experience.

Write for latest Powell Catalog T.

[This magazine will carry at an early date our announcement of entirely new and different type of Radiation Pyrometer.]

COLONIAL SUPPLY COMPANY

MILL, MINE, MACHINISTS
RAILWAY OIL AND GAS

S Co.

ELECTRICAL AND
CONTRACTORS SUPPLIES

217 WATER STREET, PITTSBURGH, PA.

Phone COurt 1042

Authorized Distributor All Types Ball Bearings Manufactured under SKF Supervision—Skayef Self-Aligning—Hess-Bright Deep Groove and Thrust Bearings.

MEASURING ∴ ∴ INDICATING .. ∴ RECORDING

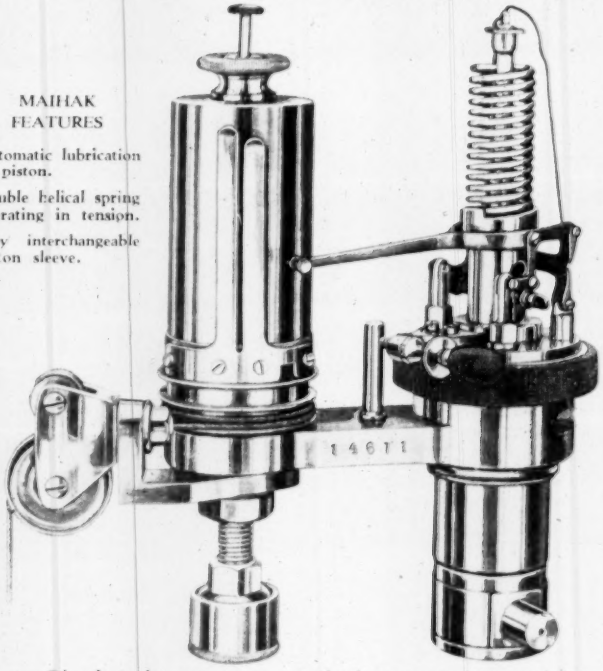
THE MAIHAK

MAIHAK FEATURES

Automatic lubrication of piston.

Double helical spring operating in tension.

Easy interchangeable piston sleeve.



Check indicator type in which you are interested

☐ Maihak Indicator No. 2—Speeds up to 400 R.P.M.
☐ Automatic Power Integrator
☐ High Speed Indicator No. 4—Speeds up to 2000 R.P.M.

NAME
TITLE
COMPANY
ADDRESS

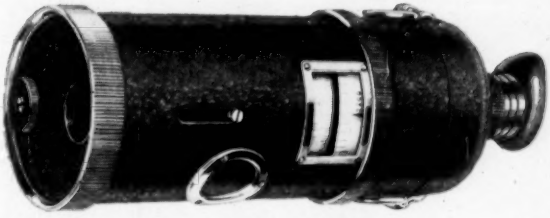
Bacharach

INDUSTRIAL INSTRUMENTS

Bacharach Industrial Instrument Co.

7008 Bennett St. Pittsburgh, Pa.

Pyrometry Simplified



The New Pyro Optical Pyrometer

Pyro Insertion Pyrometer

Entirely self-contained. No outside batteries, no accessories. No calculating, no opportunity for mistakes in judgment.

Pyro Radiation Pyrometer

Write for bulletins

Pyro

Pyrometer Instrument Co. 74A Reade St., New York, N. Y.

2376

RAWSON
ELECTRICAL INSTRUMENT CO.
INCORPORATED
CAMBRIDGE, MASS.
SPECIALISTS IN HIGH SENSITIVITY METERS

MULTIMETER

SINGLE PIVOT

BI-PIVOT

RAWSON METERS

Are Giving General Satisfaction in the Leading Laboratories of America and Abroad

ELECTROSTATIC VOLTMETER

D. C. MULTIMETER, 13 ranges, Reading currents from microamp. to 1 amp. and Voltages from 50 micro volts to 600 volts. Suitable for use with RAWSON THERMO COUPLES IN VACUO on RADIO FREQUENCIES.

A. C or D. C. THERMAL MULTIMETER, 13 Ranges, Reading from 2 milliamps to 1 amp and 60 millivolts to 1000 volts with resistance of 100 ohms per volt. Suitable for use on D. C. or AUDIO FREQUENCIES.

ULTRA SENSITIVE SEMI-SUSPENDED METERS for currents to .02 microamp and 2 microvolts.

ANY single or multirange included in above can be supplied.

ELECTROSTATIC VOLTMETERS, single or multiple range from 0-120 volts to 2500 volts for use on A. C. of Commercial or Audio Frequency. Practically NO LOAD on circuit. IDEAL for use on output voltages on Radio Sets and testing capacity and insulation of small condensers. Also OPEN CIRCUIT VOLTAGES ON B ELIMINATORS.

WATTMETERS single and multirange for use on D. C. or A. C. having POWER FACTORS between Unit and .01

LUSH CABLE TESTERS for general testing and high resistance faults.

McCOLLUM EARTH CURRENT METERS for measurement of Electrolysis in buried structures.

Write for Bulletins

Factory & Engineering Dept.
90-92 Windsor Street
Cambridge, Mass.

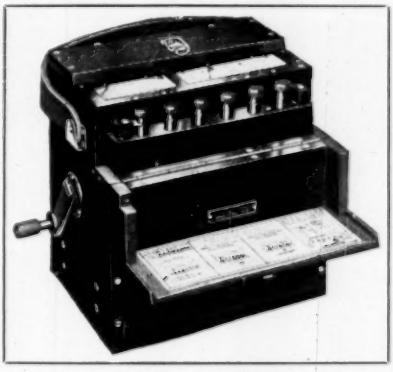
Branch: Sales and Service
91 Seventh Avenue
New York City

80% reduction in motor trouble due to sudden insulation failure at a cost of

86c per motor per year

That is what a "2 in 1" Megohmer accomplished for the Kewanee Boiler Company according to a Nielsen Certified Performance Survey.

Copies of this survey will be mailed upon request.



"2 in 1" MEGOHMER

Used by leaders in various industries such as

United States Steel Corp.
General Motors Corp.
Lehigh Portland Cement Co.
American Gas & Electric Co.
New York Central Railroad
National Aniline & Chemical Co.
General Electric Co.
National Biscuit Co.
International Paper Co.
United States Rubber Co.
etc.

Herman H. Sticht & Co.

21 Park Row,
New York, N. Y.

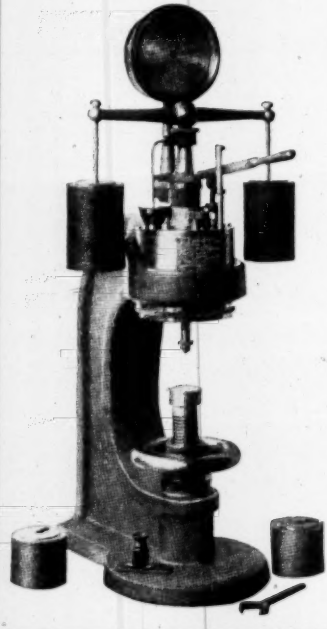
Herman H. Sticht Company,
21 Park Row,
New York, N. Y.

Send Bulletin 162 containing a full description of the "2 in 1" MEGOHMER

Name

Street

City



Brinell Testing Machines

Hand and Power Operated

Brinell Microscopes, Micrometers and Depth Gauges to measure ball test indentations.

Pittsburgh Instrument & Machine Co.

1026 Reedsdale St. Pittsburgh, Pa.

Manufacturers of

BRINELL MACHINES, SHEET METAL TESTERS, SURVEYING INSTRUMENTS and SPECIAL APPLIANCES

Type P-30

Hoyt Switchboard Meters

The HOYT P-30 Meter is representative of the Hoyt Line of Switchboard instruments in all sizes from 2¼ to 8" diameter. All have hand-calibrated scales—good damping, carefully built movements.

Voltmeters—Ammeters—A.C. and D.C.

Pin this advertisement to your letterhead and mail it to us for catalog "HOYT SWITCHBOARD METERS."

HOYT ELECTRICAL INSTRUMENT WORKS

BURTON-ROGERS CO.

Sole Selling Agents

BOSTON MASSACHUSETTS

Portland Meters and Counters

For Measuring and Counting

Remarkable Accuracy and Endurance

ADDE & COMPANY, Portland, Maine

"FENNEL"

LEVELS, TRANSITS & TACHEOMETERS

are Surveying Instruments of highest Precision

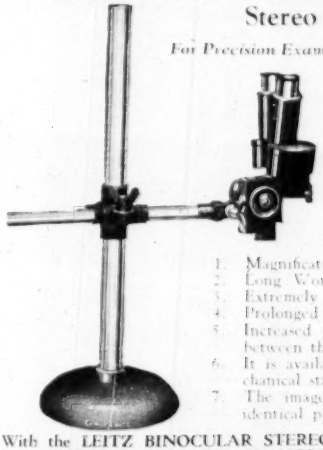
Write for Catalogues to

OTTO FENNEL SONS, Kassel, 85, Germany

LEITZ New Universal Binocular

Stereo Microscope "UBM"

For Precision Examination and Control in Industrial Shops



Old and inadequate control methods, used in many shops are unreliable, tiresome and what is of greatest importance, they mean a brake to rational production.

Leitz Binocular Stereo Microscope "UBM" will eliminate all these shortcomings due to their many outstanding features, some of which are:

1. Magnifications from 4x to 216x diameters.
2. Long Working Distance (maximum 120mm).
3. Extremely Large Field (maximum 45mm diameter).
4. Prolonged use does not fatigue the observer's eyes.
5. Increased Stereoscopic Vision due to the wide angle between the two lines of vision.
6. It is available for use with a variety of different mechanical stands.
7. The image is erected and the object is seen in the identical position as with the naked eye.

With the LEITZ BINOCULAR STEREO MICROSCOPES "UBM," the Time of Control Work IS REDUCED BY MORE THAN 50 and the EFFICIENCY INCREASED BY AT LEAST 100 .

Write for Pamphlet (H) 1102

E. LEITZ, INC. **60 East Tenth Street, New York, N. Y.**

AGENTS: Pacific Coast States: Spindler & Sauppe, Offices at San Francisco and Los Angeles, Calif. Canada: The J. F. Hartz Co. Ltd., Toronto 2, Canada. Philippine Islands: Botica de Santa Cruz, Manila, P. I. Cuba: Antiga & Co., Havana, Cuba.

WANTED

Several territories are open for energetic representatives to handle our nationally known and advertised portable "PYRO" Pyrometers. Active salesmen calling on industrial plants of every description can have good income even as a side line. State experience.

Pyrometer Instrument Co.
74 Reade Street
New York, City

When in need of

CONTROLS, THERMOSTATS, ELECTRIC HEATING UNITS, OIL PRE-HEATERS, PLATTENS,

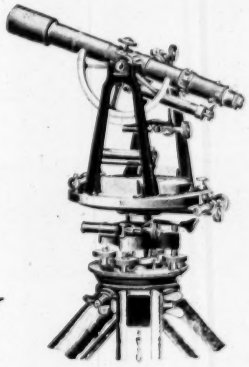
Storage and circulation type electric water heaters for homes and industry. Special electric heat applications for performance to the entire satisfaction of the user . . .

Write Us!

THE AUTOMATIC ELECTRIC HEATER CO.
1505 Race St., PHILADELPHIA, PA.

Over 50,000 installations in the United States and foreign countries will vouch for the quality of our products.

Instruments *and* Supplies FOR EVERY INDUSTRY



CORRESPONDENCE
INVITED
ILLUSTRATED
LITERATURE
ON REQUEST

Blue Print Dryers
Paragon Blue Print Machines
Revolute Blue Print Machines
Blue Streak Blue Print Machines

Anemometers
Aneroid Barometers
Mercurial Barometers
Rain Gauges
Recording Barometers
Thermometers
Transits and Levels
Drafting Room Tables
Drafting Machines
Plan Filing Cabinets Metal or Wood
Drawing Materials
Drawing Instruments
Industrial Motion Picture Projectors
Photostats and Blue Prints
Blue Print Papers
Brown Print Papers

Transits and Levels Repaired

B.K. ELLIOTT COMPANY

127 Sixth Street
Pittsburgh,
Penna.

734 Prospect Avenue
Cleveland,
Ohio

INSTRUMENTS

INDUSTRIAL — SCIENTIFIC

Published Monthly by

INSTRUMENTS PUBLISHING CO.

1117 Wolfendale Street · Pittsburgh, Pa.

George L. Ray, President Richard Rimbach, V. P. & Treas.

Vol. 1. No. 2 PITTSBURGH, PA. February 1928

TABLE OF CONTENTS

	PAGE
Editorials:	
To Our New Readers	77
"It Must Be Inexpensive"	78
Insulation Measurement	79
Who's Who	80
The Favorite Pastime "Getting Rid of a Salesman"	81
Instrument Pioneers—Alessandro Volta (1745-1827)	83
Comparison of the Various Methods of Testing the Hardness of Metals—D. L. MATHIAS	87
Instrument for the Measurement of Electrical Insulation—A. WATSON	93
Measuring to Four Parts in a Billion—P. P. CIOFFI	99
The New Improved Type of Brady B.T.U. Indicator—R. A. MALONEY	105
The Measurement of Luster—DR. W. EWALD	111
Information Section	114
New Instruments:	
Portable Recording Thermometer	115
The Hammer-Fennel Tacheometer Model 1927	117
Tag Steam Operated Controller	119
The Offset Receiver	121
The Synchronometer	123
Readers' Comments	126
Catalogue Library	13
Review of Recent Patents	15
Current Literature Review	18
Buyers' Guide	24
Advertisers' Index	30

Have your stenographer cut out and file the 3 x 5 cards found bound in the back of this issue, listing the principal articles. They will direct you to valuable information to which you may wish to refer in the future.

The ROCKWELL Hardness Tester

IT is an important advantage in hardness testing, either in research or inspection work, to be able to carry out tests on "round" stock, for example, and to compare with results of tests on flat surfaces. If the radius of curvature of the piece being tested is not under 3/16" this can be done with the Rockwell.

WILSON-MAEULEN COMPANY INC

381 Concord Avenue New York

INSTRUMENTS

INDUSTRIAL — SCIENTIFIC

(Copyright, 1928, by Instruments Publishing Company)

Vol. 1. No. 2. FEBRUARY 1928 Pittsburgh, Pa.

To Our Readers:

INSTRUMENTS, a new publication devoted to the instrument problems of all industries, made its first appearance last month. Over ten thousand copies were mailed out and only those who mailed in their subscriptions receive the subsequent issues.

As we stated in the first issue, we feel that in presenting INSTRUMENTS, we are rendering a distinctly valuable service by disseminating information on the uses of instruments in science and industry. Devoted exclusively to instruments, the journal fills a long felt need, for this is the first time that instruments for use in all industries will be covered by a single publication. Our purpose is to act as a clearing house for vital information and as a medium for the exchange of ideas on this subject.

We take this opportunity to again point out some of the special features of this periodical:

1. The feature articles are listed on the front cover. Opposite each title is a space for placing the initials of those individuals in your organization who may be interested in that article.

2. In addition, the feature articles are also listed in the table of contents and on file cards, which you will find bound into the back of this book. These file cards are printed on a special colored stiff paper for your convenience. This card gives the title; author's name; date of issue, volume and number of issue and pages on which the article appears. You will also find an abstract of the article on this card.

3. The original articles will always begin on the top of the right hand page. This will permit removing any article in the journal without destroying the previous or following article.

4. Every effort will be made to cover the new developments of the various instrument companies. These descriptions will also begin on the right hand page the same as the original articles.

5. The Information Section, and Review of Current Literature will be printed on only one side of the page, carrying an advertisement on the opposite side. This will permit cutting out such material without destroying other information which you also may desire to file.

6. The Patent Review, Catalog Library, Buyers' Guide and Advertising will contain valuable information.

On page 110 is shown a list of the subjects which will be covered in subsequent issues of INSTRUMENTS. These articles will be of unusual importance and interest to you.

A number of companies have purchased space in INSTRUMENTS. Their support assists in making this journal possible. Their continued support will naturally depend on you. They have made an investment which consists of the purchase of space in this journal to transmit their sales message to you. If you approach these companies or any others in regard to information appearing in INSTRUMENTS, mention that you saw it in INSTRUMENTS.

You have had the opportunity to become familiar with INSTRUMENTS. It is the only trade publication devoted exclusively to this important field. It will bring to you all the important developments. It will not only discuss your problems but will suggest means for solving them.

No man or organization interested in the use of instruments can afford to miss a single issue.

We urge you to fill out the subscription blank and mail it back to us at once so that you may be sure to receive all future issues.

"It Must be Inexpensive"

AT a recent meeting of manufacturers and users of a raw material, a specification was written covering an instrument to test that material. This specification was then passed to a committee of instrument manufacturers.

The first clause read "It must be inexpensive." What did this mean. An instrument, testing machine or other measuring device may be expensive and still be cheap. The cost of such equipment should be considered on the basis of return on the investment; that is estimating the saving due to reducing operating costs, increasing production, etc., and then calculating the percentage return on the cost of the machine.

Also, as is known, the price of any commodity is governed by the law of supply and demand. A manufacturer figures his selling price from the production and overhead costs adding a percentage profit. If he only sees the opportunity of selling one instrument, the overhead must all be added to the one and naturally the price will be high. If he is assured of selling a number of instruments, the overhead can be distributed over a number of them.

Assuming that an instrument manufacturer is unreasonable and charges an excessive price, it will not be long before a competitor will find a way of making the instrument and selling at a lower price, thus the price eventually adjusts itself.

It seems, though, that the instrument manufacturer is expected to be a philanthropist, who makes instruments to give away below cost. If this

were true he would not be in business very long. Like every other manufacturer, he also must make a profit.

Keep this in mind, when you feel inclined to kick about high prices.

Insulation Measurement

THE selection of insulating materials has been largely based upon experience gained in cut-and-try methods, but in the past five or six years testing of a more general and uniform nature has been carried on with a view to establishing the specific properties of the materials most generally used.

However, even the testing of the past few years has been carried on in a haphazard manner without regard to correlating the tests with those made upon similar materials by other investigators. Usually the builder of electrical equipment conducts improved tests to determine the suitability of the material for his particular purpose, and the results are not ordinarily of value to those interested in other types of apparatus or fields of service.

In testing work, insufficient consideration has been given to the effect of various conditions upon the resulting values. Temperature, humidity, thickness of specimen, time period of voltage application, frequency, pressure of electrodes, and other conditions all have a marked effect upon the values obtained and unless these conditions are reported with the results the latter cannot be taken as strictly indicative of the true comparative value of the insulation.

The conditions under which electrical apparatus is to be employed often dictate the form of insulation to be used, aside from the design and efficiency demands of apparatus at the test room.

For motors or other electrical equipment used in mines, the insulation must not only be resistant to moisture, but must very often resist mine water of an acid nature which is very injurious to some types of insulation. In metal mines there is also the possibility of the abrasive action of dust and the conductivity of metallic particles. In coke plants, boiler rooms and factories where powdered coal is used, the insulation of electrical apparatus is subjected to electrically conducting dust which frequently covers the windings and upon becoming mixed with oil or water may find its way into the innermost parts of the machine. One of the most severe conditions for electrical apparatus is in chemical plants where nitric and sulphuric acid vapors and sometimes the acid solutions themselves are encountered. In some factories caustic soda liquor splashes upon motors operating the equipment. Severe and extreme conditions are also encountered in steel mills, packing plants, fertilizer factories, cement mills, refrigeration plants, ships, dry docks, irrigation projects, etc.

Who's Who

At the suggestion of some of our collaborators, who were approached for information on the professional standing of the men who have consented to guide the editorial policy of INSTRUMENTS, we are giving this information below:

ADVISORY ABSTRACT EDITORS

JOHN GAMBLE, Technology Librarian, New York Public Library, New York, N. Y.

E. H. MCCLELLAND, Technology Librarian, Carnegie Library, Pittsburgh, Pa.

COLLABORATORS

PROF. F. C. ASHE, Head of Electrical Equipment and Construction Department, Carnegie Institute of Technology, Pittsburgh, Pa.

DR. JAMES ASTON, Head, Department of Mining and Metallurgy, Carnegie Institute of Technology, Pittsburgh, Pa., and Consulting Metallurgist, A. M. Byers Company.

DR. G. BERNDT, Professor an der Technischen Hochschule, Dresden, Germany.

DR. F. L. BISHOP, Professor of Physics, University of Pittsburgh, Pittsburgh, Pa.

PROF. WM. G. BROWN, Asst. Professor of Aeronautics, Massachusetts Institute of Technology, Cambridge, Mass.

R. L. DUNLAP, Power Department, Bell Telephone Company of Penna., Pittsburgh, Pa.

OWEN W. ELLIS, Research Engineer, Research Bureau, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

DR. WALDEMAR EWALD, Physicist, Askania-Werke, A. G., Berlin-Friedenau, Germany.

PAUL B. FINDLEY, Editor, Bell Laboratories Record, Bell Telephone Laboratories, New York, N. Y.

PROF. J. B. GRUMBEIN, Professor of Steam and Experimental Engineering, University of West Virginia, Morgantown, W. Va.

ROBERT G. GUTHRIE, Consulting Metallurgist, Peoples Gas Light and Coke Company, Chicago, Ill.

PROF. LESTER HAMILTON, Associate Professor of Analytical Chemistry, Massachusetts Institute of Technology, Cambridge, Mass.

JOHN L. HODGSON, Technical Expert, George Kent, Ltd., Eggington, England.

PROF. GEORGE HOSMER, Professor of Geodesy, Massachusetts Institute of Technology, Cambridge, Mass.

PROF. J. W. HOWARD, Associate Professor of Topographical Engineering, Massachusetts Institute of Technology, Cambridge, Mass.

PROF. HANS VON JUEPTNER, University of Vienna, Vienna, Austria.

DR. FRIEDRICH KOERBER, Director of the Kaiser-Wilhelm-Institut fuer Eisenforschung, Dusseldorf, Germany.

DR. V. M. KRIVIBOK, Asst. Director, Metallurgical Research Bureau, Carnegie Institute of Technology, Pittsburgh, Pa.

A. A. LEBEDEFF, Physicist of the Optical Institute, Leningrad, Russia.

JOHN M. LESSELLS, Engineer in Charge, Mechanics Section, Research Laboratory, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

RICHARD R. MOORE, Engineering Department, Wright Aeronautical Corporation, Paterson, N. J.

DR. ALLEN LESLIE NORBURY, Senior Metallurgist, British Cast Iron Research Association, Birmingham, England.

PROF. P. H. SCHWEITZER, Associate Professor of Engineering Research, Pennsylvania State College, State College, Pa.

DR. HARRY SELTZ, Asst. Professor of Chemical Engineering, Carnegie Institute of Technology, Pittsburgh, Pa.

THOMAS SPOONER, Asst. Director, Research Laboratory, Westinghouse Electrical and Manufacturing Company, East Pittsburgh, Pa.

FRANCIS M. TURNER, JR., Vice-President and Editor, Chemical Catalog Company, New York, N. Y.

DR. S. R. WILLIAMS, Professor of Physics, Fayerweather Laboratory of Physics, Amherst College, Amherst, Mass.

PROF. W. R. WORK, Head of the Department of Electrical Engineering, Carnegie Institute of Technology, Pittsburgh, Pa.

C. B. WRIGHT, Supt. Power Distribution, Duquesne Light Company, Pittsburgh, Pa.

The Favorite Pastime—"Getting Rid of a Salesman."

ONE of America's greatest executives while acting as assistant purchasing agent of his company, saw everybody who called at the office. Every salesman, no matter what he had to sell, was granted an interview. He quizzed them on manufacturing processes, shipping problems of their respective companies, sources of raw materials, costs, etc. Simultaneously he studied the men themselves. He analyzed their various "approaches," their ways of presenting arguments, the manners of those who impressed him favorably, and the faults of those who impressed him unfavorably.

How many do this? When a business man receives the card of a salesman, his first instinct is to put up a vigorous—and usually successful—defense. The language of business is full of hard worked phrases that are constantly used to shut off men who call with something to sell. "Tell him I am dictating," "Take him to see Mr. So-and-So," "Say that I am in conference," are the more polite forms.

This hurts a man's feelings deeply, when absolutely and even discourteously refused an interview with a prospect, particularly when one can look into the alleged busy gentleman's office and see him reading newspapers and smoking cigarettes.

Another method of "turndown" is to receive an interview with some second assistant purchasing agent who has no authority whatever. These things are particularly aggravating when they occur in some out of the way place that requires a half day to reach and another half day to return, and the concern called on is the only prospect in town.

"Getting rid" of salesmen is an act in which much skillful mental foot-work is used. Some men pride themselves on their ability to "kiss a man out of the office" in a matter of seconds. They grasp the caller's hand cordially, place the other hand on his shoulder in friendly fashion, and steer him gently to the door of the elevator.

There is another annoying thing, and that is the self-styled "very busy" prospect, who will take up from one-half to an hour of a salesman's time and sometimes make him miss a train, merely telling how very busy he (the prospect) is, without ever giving the salesman a chance to state his business. The whole interview in all probability would have consumed no more than 5 minutes of the man's time had the salesman been given a chance.

This is Waste?

It will be worth your while to meet all salesmen, especially those representing instruments companies. These men are more than salesmen—they are engineers, who have received special training and experience. When they call, talk over your measuring problems with them. It may be a means of your saving your company considerable money.

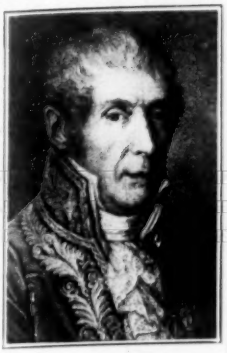
The editor realizes there are two sides to every question. Some salesmen seem to have a faculty which amounts to positive genius, for always calling at the busiest time of the day, taking up a lot of time and throwing the entire working of an office out of gear, by indulging in lengthy conversations which are of no interest and frequently have no bearing whatever on the business.

It is certainly nerve-racking when one has been delayed unduly though unavoidable incidents connected with starting the day's work at his business, to have some salesman come in with the "standard approach" and bore one for an hour or so with a standardized lecture which he has learned in the school of salesmanship and rehearsed so many times that he rattles it off like a phonograph, and in some instances seems to sing it. This is the more irritating when one has heard the identical story many times before.

Spread the Information Around

FROM the very large number of subscriptions we are receiving from people who did not receive a sample copy of INSTRUMENTS, but had the opportunity of seeing it through friends of theirs, the editor believes there are a large number of people who would be anxious to subscribe to INSTRUMENTS if they knew of the existence of such a paper.

Therefore, if you are a subscriber or receive a sample copy of INSTRUMENTS pass the word along to the men you know have a vital interest in instruments. For this reason subscription blanks are placed in all copies of INSTRUMENTS. If we have received your subscription pass the blank along to some one, whom you feel is also interested.



Instrument Pioneers

Alessandro Volta
(1745-1827)*

ALESSANDRO GIUSEPPE ANTONIO ANASTASIO VOLTA was born on February 18, 1745, at Como, Italy. The parents of Alessandro were Phillippe Volta and Madeleine de Conti Inzaghi. With a happy disposition, great powers of application, a sense of order, and his father's guidance in his studies, he soon attained an enviable place amongst his fellows at the public school of Como. The Royal Seminary at Como put the finishing touches upon his education, and as far as can be judged, his early leanings were toward prose and verse. By the time he was 24, however, chemistry and electricity cast upon him spells that caused Italy to lose a poet, and natural science to gain a pioneer.

Volta was not destined to be merely a chemist and a physicist; he became a man of affairs who directed the thoughts of Europe to noble purposes. In 1777 he travelled to Switzerland, and met De Saussure, Voltaire, and other men of thought and distinction. Two years later he was called to occupy the chair of physics at Pavia. In 1780 he visited Bologna and Florence. In 1782 he proceeded to Germany, Holland, England and France, to confer with Lichtenberg, Van Marum, Priestly, Lavoisier and Laplace, and incidentally to enrich the laboratory at Pavia with instruments for research and demonstration.

Volta married on September 22, 1794, Donna Teresa Perigrini Ludovico. During the next five years, he wrote some of his most valuable memoirs, and secured universal fame. To realize the conditions under which he was carrying out his researches at this time it must be remembered that all Europe was at war, and that his home at Como was at the very vortex of the tempest that raged between Austria, France, and Italy.

Time, place and circumstances conspired to establish friendly relationships between Volta and Napoleon. In 1801, at Napoleon's invitation, Volta visited Paris and gave a demonstration before a large meeting of the French Institute for which Napoleon proposed that Volta receive a gold medal. He also bestowed upon him 2,000 crowns for his

*Abridged by permission from "Electrical Communication."

traveling expenses and decorated him with the Croix of the Legion d'Honneur and with the Couronne de Fer. He nominated him a member of the Italian Consulate, and raised him to the dignity of Comte and Senator of the realm of Lombardy.

The century that has elapsed has confirmed the value of the discoveries associated with the name of Volta: the electrophorus, the Volta "pistol," the eudiometer, electric signalling, the condensing electroscope, the apparatus for exploring the electric charges in the atmosphere by means of a flame, and the Volta pile in its various forms.

The evolution of the electrophorus is somewhat difficult to trace. In England, John Canton (1718-1772) established the principle of electro-static induction. Johann Karl Wilcke (1732-1796) in Stockholm, and Franciscus Alpinus (1724-1802) in Berlin, found that a plate of air could be charged like a plate of glass. Volta applied the principle of electro-static induction, and designed the electrophorus with such knowledge and skill that no improvement upon it has been found during the century.

In the spring of 1782 he journeyed to England. He examined the manufacturing centers, the canals, and the harbors. He saw Oxford University and included in his tour Chester, Shrewsbury, Bridgnorth, Worcester, Gloucester, Bath, Bristol, and Liverpool. At Portsmouth he visited the Fleet under Admiral Howe; and at Greenwich he went over the Royal Observatory.

During his stay in England he became acquainted with Dr. Joseph Priestly (1733-1804), Sir Joseph Banks (1743-1820) and other Fellows of the Royal Society, with the result that on March 14, 1782, a paper by Volta was communicated by the Right Honorable George Earl Cowper to that Society and was published in the Transactions of that year, Volume 72, page 237, under the title, "The Method of Rendering Very Sensible the Weakest Natural or Artificial Electricity." Volta there describes his electrophorus as "a machine well known to electricians." He states that it might better deserve the name of "electrometer" or micro-electrometer," but that he preferred to call it a "condenser of electricity."

It appears, therefore, that he recognized it as primarily an apparatus for facilitating the measurement of electric charges, rather than as a generator of static charges. In this manner he associated it with his condensing electroscope, which could be used for detecting extremely small charges.

Arago describes Volta's condensing electroscope as a veritable microscope, and in the hands of the pioneers, it has been a valuable aid to quantitative research. In 1791 Volta was elected a foreign Fellow of the Royal Society, chiefly on account of the discoveries disclosed in his communication of 1782.

The fact that the theory of the condenser was known before the

work of Volta, in no way detracts from the value of his work on the condensing electroscope. Thomas Thomson, the historian of the Royal Society wrote: "We are more indebted to Mr. Volta than to any other philosopher of the present age for the introduction of new and important electrical apparatus. In this paper (Phil. Trans. R.S., 1782) he gives us an account of his condenser; a very useful instrument for detecting the presence of small quantities of electricity. By means of it Lavoisier, Laplace and himself, succeeded in ascertaining the existence of negative electricity in the vapor of water, the smoke of burning coals, the air produced by the solution of weak sulphuric acid. . . . . "

The years following 1782 were not spent wholly in Italy. With his friend Antonio Scarpa, Professor of Anatomy at Pavia, Volta went to Vienna where the Emperor Joseph II received him in a most friendly manner. In 1784 he visited Berlin, and in 1787 he was at Geneva discussing French poetry with De Sausseure. On August 30, 1789, Luigi Galvani of Bologna observed by chance the convulsions of a dead frog that was in contact with metal, which he published in 1791. On April 3, 1792, Volta wrote to Galvani concerning the frog movements, and a few weeks later he spoke in praise of the discovery. During the summer of 1792, however, he became dissatisfied with Galvani's explanation of the phenomena, and he concentrated upon the problem of contact-electricity.

In 1794, the Royal Society awarded the Copley Medal to Volta, six years before his invention of the electric pile. It is usual to associate his conception of a continuous current with his discovery, probably towards the end of the year 1799, of the pile. The quotation from his letter to Tiberius Cavallo, an Italian physicist resident in England, however, leaves no doubt that he had a vision of such a current in 1792, and that the production of a continuous flow became his objective.

Volta's paper "On the Electricity Excited by the Mere Contact of Conducting Substances of Different Kinds" is published in the Philosophical Transactions of the Royal Society, (Volume 90, 1800). It is written in French, and takes the form of a letter addressed to the Right Honorable Sir Joseph Banks, Bart., K.B., President of the Royal Society. It was read on June 26, 1800. In the History of the Royal Society it is explained that owing to the state of hostilities that then existed between England and France, one portion of the paper arrived in London several months before an opportunity occurred for sending the remainder. This delayed publication of the discovery of the pile, and in consequence apparatus was constructed and various curious experiments by different persons in London were made in advance of the original paper being laid before the public.

Arago, his contemporary, expressed the opinion that Volta's pile was the most marvelous instrument that human intelligence had ever created. The discussion, which began in his day, regarding the seat of the

electromotive-force, extends into the present century, and it is as far as ever from settlement.

In April, 1805, Volta wrote to Humboldt stating that he was engaged upon electrometry, particularly with regard to the capacity of conductors of various forms and sizes, and the relationship of capacity to electric pressure, or tension. He found that the tension diminished exactly as the capacity was augmented. In July, 1808, he was asked by the representative of a Russian University to transfer his home to that country but he declined.

In 1819 Volta quitted the University and retired to Como. His relations with the world of science then ceased. In 1923 he had a slight attack of apoplexy, and on March 5, 1827, after a fever, at the age of 82, he died.

By immortalizing his name in the unit of electromotive force, the electrical science long ago placed their laurels upon Volta. Testimony of his originality and of the scope of his activities is to be found in what remains of his apparatus, and in the literature that has been so carefully brought together in Italy concerning his achievements. Unfortunately, a considerable amount of his original apparatus was destroyed in the disastrous fire that occurred at Como on July 8, 1899.

———::———

Josiah Wedgwood, a celebrated potter of Staffordshire, England, introduced the first practical instrument for measuring high temperatures in 1782. This was based on the progressive contraction of clay baked at increasing temperature. It was without a rival for forty years and is still in limited use.

———::———

In 1822, Johann Thomas Seebeck, a German physicist, discovered thermoelectricity by determining that a flow of current could be produced by heating the junction of two different metals, the current increasing with the temperature. This principle was not adapted for practical use in connection with pyrometers until about 1886.

———::———

Claude Servais Mathias Pouillet, eminent French scientist and man of letters, investigated pyrometry extensively in 1835 using a platinum bulb gas thermometer. He also made and calibrated the first practical thermocouple, platinum-iron. He anticipated the method of measuring temperatures subsequently developed by Violle, through determinations of the specific heat of platinum. Pouillet also took the first definite steps in radiation pyrometry, by investigating the temperatures at which solids glow.

Comparison of the Various Methods of Testing the Hardness of Metals

*By D. L. Mathias, Pittsburgh, Pa.**

HARDNESS in its broadest sense is the property of a material to resist deformation by external forces. This deformation may assume different forms, although it usually occurs as either an elastic or a plastic change in shape.

In addition to the geologist, who uses a scratch hardness test based on Mohr's tests, the metallurgist uses hardness tests for estimating the physical properties of his material. For this reason the property of hardness has been correlated to the other properties of the material and expressed in numbers without regard to the physical processes involved, or to any sharp definition of the property itself. The advantages of the hardness tests are:

1. Wide applicability;
2. Ease and rapidity with which they can dependably be carried out by men with only little training for that purpose.
3. Making of special test pieces largely unnecessary.
4. Finished work may be tested without fear of damage; and
5. Permit drawing conclusions in regard to some of the other physical properties, especially the tensile strength.

Hardness testing is especially valuable in the control of finished material. In many plants each piece is tested, as they are not affected by the test, which itself is simple and quickly carried out. Hardness tests may also be used for: The inspection of outgoing material, examination of hardening quality as well as uniformity of hardening, determination of proper cold-working, checking of heat treatment, sorting of materials carried in stock, as well as superficial testing for composition and impurities.

The results of hardness tests made in actual practice are not used to the extent they might be. A comparison of results, obtained over a considerable period of time, would be an excellent means of gauging the success of production, and the uniformity, and hence the quality of each lot of material manufactured. In order to obtain values though which will permit comparison, it is necessary that care be taken to have uniform testing conditions. The literature frequently gives hardness test results which are of no value, because the information relative to the conditions under which the tests were carried out is not complete or has been omitted. Such omissions are particularly serious where several methods of hardness testing have been used.

*Metallurgist, Mackintosh-Hemphill Company.

A number of different methods for the determination of those properties of metals commonly termed "hardness" are in common use. Among these methods the Brinell ball hardness method, introduced about 1900, is the most commonly used. This method is based on the resistance offered by a body to the penetration of a hardened steel ball under a fixed load. For practical reasons, the load on the ball is considered relative to the spherical area of the impression because, in this way, the deviations in depth of impression caused by the work hardening of the material under test, are taken into account. The result of the Brinell test is expressed by a number which ranges from about 60 for soft metals to about 600 for very hard steel. Brinell's first tests were made in a tensile machine and the special testing machine was not built by him until later. Today there are a vast number of different designs of ball test machines, differing in size, power and method of applying the load. There are also available hand testing machines.

The Brinell method is largely used in the metal industry, not only for the determination of hardness, but also for the determination of other properties, some of which bear almost an exact relation to the hardness number, while others may be determined with a sufficient degree of accuracy. The tensile strength of some materials, as for example carbon steel, can thus be determined with sufficient accuracy for all practical purposes.

The Brinell Test consists of placing a ball of definite diameter under a definite known load, and in measuring the area of the impression thus produced in the piece under test. There are several factors which influence the results and which therefore must be taken into consideration. First, a ball of proper size, must be chosen, which depends upon the dimensions of the sample and the structure of the material. For testing small samples, small balls should be used, otherwise the edge of the impression may bulge out, and the resulting hardness numbers will be too low. The thickness of the sample should be sufficient to prevent the pressure from being affected by the condition of the anvil on which the piece under test is resting. An item of special importance is the size of the load. Hardness numbers will only be correct if the load is such that the diameter of the impression ranges from 2/10 to 5/10 of the ball diameter. In testing metals which have a strong tendency to flow, such as zinc, enough time should be allowed to produce maximum penetration. The duration of the test should be about 30 seconds.

The diameter of the impression is usually ascertained by means of a measuring microscope. A magnification of ten permits hundredths of millimeters to be estimated, and is therefore of sufficient power for impressions made with a 10mm ball. With a 2.5 mm ball it is necessary to use a measuring microscope of higher power. If the impression is out of round, the mean diameter must be determined. Often the formation of the crater around the impression makes exact measurements

difficult. Where the edge of the impression is rounded or not sharply defined, it will not be possible to measure accurately.

In the case of the Brinell test, considerable work is being done to do away with the separate measurement of the diameter of the impression, and to substitute for it the depth of penetration reached during the test. Difficulties are often encountered by reason of the formation of the crater around the impression and because the unevenness of the surface prevents the measurement of the depth of penetration from being carried out with sufficient accuracy. Some years ago, however, Rockwell worked out a method based on the same principle in which a small hardened steel ball or a diamond cone is first imbedded in the sample under a fixed initial load. The position of the point under this initial load is assumed as zero, and the depth of penetration, resulting from the main load, which is approximately ten times that of the initial load, is measured in terms of the movement of the piston. The hardness is found by comparing the difference of the two impressions made by the ball or cone on a dial under two different, but standard pressures and can be read on a dial in thousandths of a mm. This method is becoming more and more used. Its advantages are the rapidity with which the tests can be carried out, the very slight indentations made in the piece, and the fact that very small and very hard parts can readily be examined.

There are several methods for determining hardness, in some of which the dynamic reaction of the material resulting from the impact of the ball is used to determine the hardness. In the impact test, a light hammer having a ball-pointed tip at the lower end is dropped upon the test piece from a height of about 20 cm. Parts which are hard to get at or immovable are readily tested by a variation of this method in which a blow is transmitted by a spring to the ball. In a test of this kind, the mass represented by the piece and the manner in which it is mounted must be taken into consideration.

These factors are of even greater importance in tests, which utilize the elastic properties of the materials to determine the hardness. The scleroscope comes under this classification. In using the scleroscope the hardness is determined as a function of the rebound of a standard hammer falling vertically in a glass tube and striking the polished surface of the tested specimen.

The scleroscope gives a valuable means for checking surface hardness of a great many materials; but its use, as with all instruments based on the rebound, is limited by the necessity that the specimen have a smoothly polished surface of perfect flatness accurately leveled in the instrument. This involves considerable difficulty in testing objects of odd shape. Also the results are not easily translated into Brinell hardness numbers which now are generally used as standard. The scleroscope is suitable for checking hard metals in thin sections or the surface of case hardened objects. Similar pieces can be checked for comparison by this

method with a remarkable speed and convenience. The apparatus can be easily carried into the shop and applied to heavy masses of metal for checking the uniformity of hardness.

In testing the hardness of metallic coatings and for fragile parts, a scratch test, developed by Martens is sometimes used. A diamond cone forming a 90° angle and under a slight load, is drawn over the surface of the piece. The load required to produce a scratch 1/100 mm wide gives the measure of the hardness. A series of five scratches, each under a different load, is made on the polished surface, and from the width of the scratches, by interpolation, the load necessary to make a scratch of the standard width of 1/100 mm is found. Considerable experience is required in making this test, as it is difficult to measure the width of the scratches. The sides of the scratch made by the diamond are more or less uneven and frequently have a burr, making it very difficult to decide what the exact confines of the scratch really are. Material made up of crystals of varying hardness require special care because different crystals' surfaces are affected differently.

The scratch test is generally used in the testing of homogeneous materials, especially where the hardness is considerable, or for very thin samples. Scratch tests have as yet not been employed in this country for the practical and critical study which they deserve.

The widespread use of the Brinell machine is the result of its being the first in the field and of its reliability in the important range of medium hardness. Relatively large impressions and the use of a measuring microscope for reading, minimize the influence of slight imperfections and unevenness in the specimen. The apparatus is rugged allowing of rough handling. The results are uniform and, not much influenced by accidental conditions, hence the surfaces on which the tests are made may be comparatively rough. The results may be easily interpreted in terms of other physical properties. These features are strongly in its favor. However, the size and depth of the impression is often sufficient to spoil the surface of a finished article. The method is not adaptable for determining the hardness of quenched steels with any accuracy. The Brinell machine is not suitable for testing thin sheets or case-hardened surfaces, also in the testing of thin walled sections where there is the danger of collapse under the heavy load required by the test. The usual apparatus cannot be carried around and used on large masses due to its size. There is a personal element of error in reading the diameter of the impression and also the necessity for frequently checking the size and shape of the balls.

The Rockwell machine produces impressions which may be permitted on most finished pieces and can be read automatically with the same accuracy as the Brinell. It is equally suitable for soft and hard metals having a higher precision than the Brinell for hard metals and greater accuracy than the scleroscope for soft. The light load used does not in

troduce any difficulties in testing thin sheets or case-hardened surfaces. Rounded surfaces unsuitable for the Brinell and scleroscope methods give readings which check and there is no need for special preparation of the surface as is required for the scleroscope. Practically any object which can be carried is suitable for testing on the Rockwell machine. Its drawbacks are the necessity of comparatively careful handling to prevent damage to the diamond point; and the lack of direct application to large pieces.

Comparing the merits of these machines the author might mention that the Brinell machine indisputably leads the way especially for speed and accuracy for hardness determinations on comparatively large and unmachined pieces if they are inside of a moderate range of hardness. The scleroscope is valuable in some restricted fields of application but is not suitable for general testing.

The Rockwell instrument has considerable flexibility and is capable of excellent results in any hardness range. It is entirely suitable for delicate work of a scientific character and is also adaptable to quantity testing.

The possibilities of hardness testing are often overestimated on account of its wide use. Conclusions as to physical properties other than hardness can be correct only in so far as sufficient data showing the relation of these properties to hardness are available. The resistance to abrasion, or to cutting for instance, can only be determined in special cases. If sufficient data based on actual tests is on hand to show the relation of hardness to other properties, then hardness testing offers an excellent means for the inspection of materials as well as for laboratory research.

Instruments Editorial Staff

RICHARD RIMBACH, *Managing Editor*

ASSOCIATE EDITORS

L. E. Barbrow, Washington, D. C.
D. L. Mathias, Pittsburgh, Pa.
Herman Mezger, Pittsburgh, Pa.
Arthur Schroder, Pittsburgh, Pa.
H. Semrau, Pittsburgh, Pa.
A. Watson, Jr., Pittsburgh, Pa.

ABSTRACT EDITORS

J. B. Gessford, Pittsburgh, Pa.
M. E. Haas, Dayton, Ohio
Carl W. Kuettner, Pittsburgh, Pa.
L. A. Meisse, Mansfield, Ohio
G. S. Onori, Greensburg, Pa.
M. Berg Rimbach, Pittsburgh, Pa.
A. J. Strod, Pittsburgh, Pa.

ADVISORY ABSTRACT EDITORS

J. Gamble, New York, N. Y.
E. H. McClelland, Pittsburgh, Pa.

COLLABORATORS

Prof. F. C. Ashe, Pittsburgh, Pa.
Dr. James Aston, Pittsburgh, Pa.
Dr. G. Berndt, Dresden, Germany
Dr. F. L. Bishop, Pittsburgh, Pa.
Prof. W. G. Brown, Cambridge, Mass.
R. L. Dunlap, Pittsburgh, Pa.
Owen W. Ellis, Pittsburgh, Pa.
Dr. W. Ewald, Berlin, Germany
Paul B. Findley, New York, N.Y.
A. A. Grubb, Mansfield, Ohio
Prof. J. B. Grumbein, Morgantown, W. Va.
Robert G. Guthrie, Chicago, Ill.
Prof. Lester Hamilton, Cambridge, Mass.
John L. Hodgson, Eggington, Eng.
Prof. George Hosmer, Cambridge, Mass.
Prof. J. W. Howard, Cambridge, Mass.
Hofrat Prof. Hans von Jueptner, Vienna, Austria
Dr. Friedrich Koerber, Duesseldorf, Germany
Dr. V. N. Krivibok, Pittsburgh, Pa.
A. A. Lebedeff, Leningrad, Russia
John M. Lessells, Pittsburgh, Pa.
Richard R. Moore, Patterson, N.J.
Dr. Allan Leslie Norbury, Birmingham, England
Prof. P. H. Schweitzer, State College, Pa.
Dr. Harry Seltz, Pittsburgh, Pa.
Thomas Spooner, Pittsburgh, Pa.
Francis M. Turner, Jr., New York, N. Y.
Dr. S. R. Williams, Amherst, Mass.
Prof. W. R. Work, Pittsburgh, Pa.
C. B. Wright, Pittsburgh, Pa.

Instruments for the Measurement of Electrical Insulation

A. Watson, Pittsburgh, Pa.

It has been aptly stated that the life of an electrical device depends upon its insulation. This is true, not only of instruments, motors, and auxiliary apparatus but also of wiring and cables. In order to obtain true economy the proper insulating material must be used for each application.

What may be the correct insulating material for one application may be useless for another—or, in many cases, an expensive material is used where a much cheaper material may be entirely satisfactory.

It is not the purpose of this article to go into detail as regards the various types of insulation as each application requires separate consideration and the materials must be subjected to tests to determine the various properties. Suggestions are made below which the author hopes will assist in the selection of the proper instruments to make some of these tests.

The perfect insulator resists the flow of electric current under all conditions of temperature, humidity, mechanical pressure and at the same time resists puncture under extremely high potential. As no perfect insulator is available, let us consider the properties of insulators as we know them:

1. Dielectric Strength.
2. Dielectric Capacity.
3. Surface Leakage.
4. Leakage through the material itself.

Dielectric Strength is that quality, which resists puncture or breakdown on application of electric stress or potential—it varies almost in direct proportion as the thickness is increased and depends on the homogeniety of the material, and is stated in so many volts or kilo-volts per mil, millimeter or inch. Dielectric strength or thin samples such as paper,

NOTE:—In all the circuits shown in the figures, a low reading ammeter may be inserted at "Am." However it must be remembered that in practically all cases the time interval of a fuse is much higher than an ammeter of the same rating and unless due precaution is taken, an ammeter may be burned out before the fuse blows. It is sometimes possible to use a fuse of much lower rating than the ammeter, i.e., to use a three ampere fuse with an ammeter of five amperes at full scale, but this does not always work. A better protection in such cases is to use a short length of extremely fine copper wire (2 or 3 inches) or iron wire in the circuit, placing the wire inside a large bore glass tube to protect from cooling air currents.

Where precise measurement of the exact current is required, a low resistance vacuum thermocouple connected to a high resistance d'Arsonval type millivoltmeter may be used, protecting the thermocouple by fuses or small wires, mentioned above.

Such measurement of current is useful especially to determine the weakening effect when extremely high potentials have been applied to rubber gloves or insulators of thin cross-section.

Another method of detecting any weakening effect is to measure the insulation resistance before applying the high voltage and immediately after the application. A very decided drop in insulation resistance serves as a warning and will frequently avoid serious troubles due to placing equipment into service that has been damaged by the application of the high voltage.

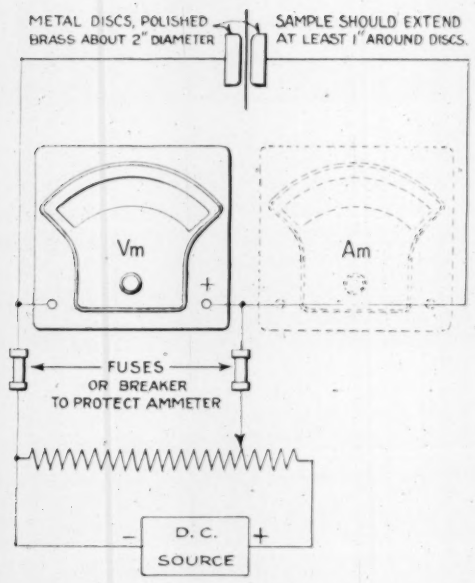


Fig. 1. Arrangement of apparatus on Direct Current for use with constant potential.

(See note on previous page.)

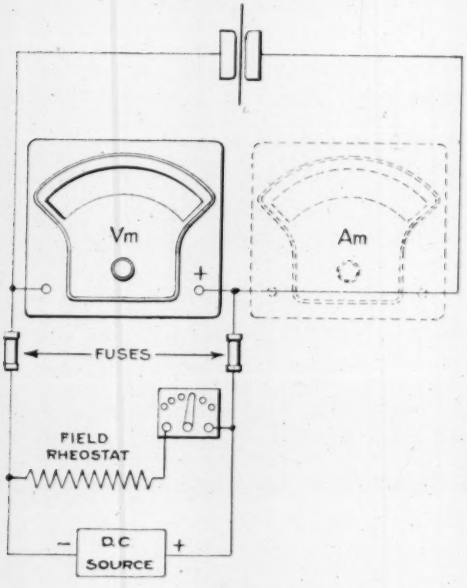


Fig. 2. Arrangement of apparatus on Direct Current for use with small generator.

(See note on previous page.)

etc., for armature slot insulation is generally determined by placing a sample of the material between two circular brass discs and applying a gradually increasing voltage across the discs until the material is punc

tured, the potential being measured by an accurate voltmeter. When making such a test, 60 cycle alternating current is generally used but if the material is to be used on direct current apparatus a D.C. potential may be used.

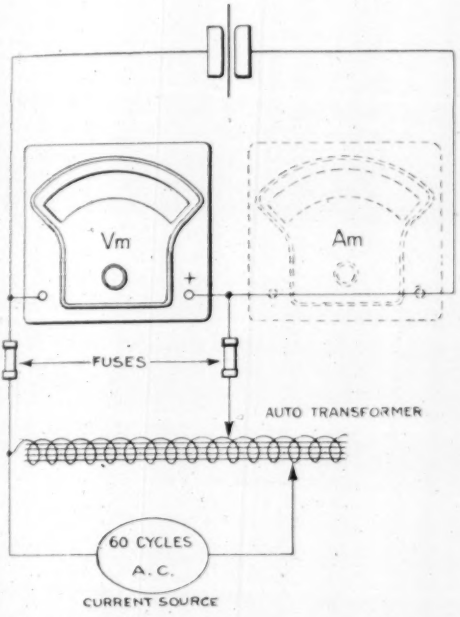


Fig. 3. Circuit for determination of dielectric strength of thin materials when using alternating current.

Such tests are very valuable especially when the sample is subject to stress under different temperatures and also before and after impregnation with various varnishes and compounds.

When testing very thick specimens the shortest distance from the center to the edge should be at least ten times the thickness, to prevent arcing over the edge.

When making such tests it must be borne in mind that the breakdown potential is governed by—the humidity, size of electrodes, shape of electrodes (that is whether edges are rounded or sharpened), also the time of electrification. Unless the same apparatus and conditions are adhered to in all tests, the comparison of two samples is useless.

To facilitate the comparison of a number of samples, the writer suggests placing the test electrodes in a glass front airtight box sealing the lead-in wires by means of special bushings. To have similar conditions under all tests a large container of sulphuric acid can be placed inside to insure dry atmospheric conditions; or a jar of water will insure saturated humidity conditions. Using the same electrodes for all tests and rounding their edges, and using a spring arrangement for one electrode will insure

the same physical conditions. The standard electrodes of the American Society of Testing Materials may also be used.

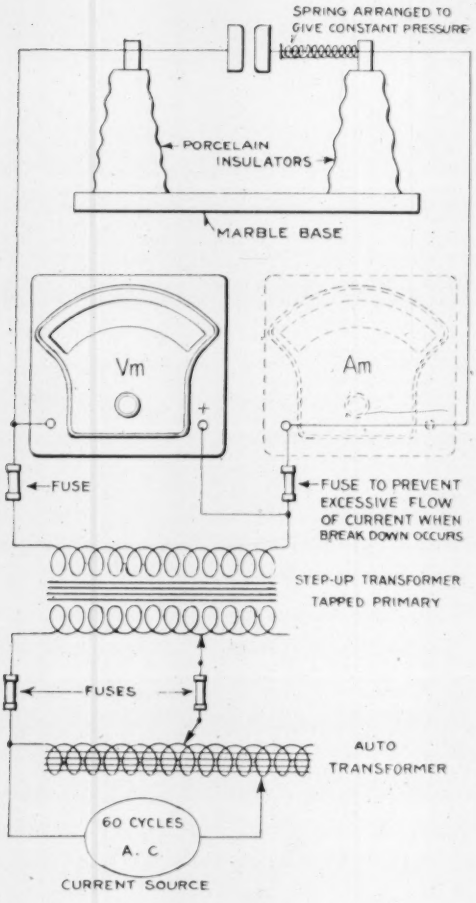


Fig. 4. Arrangement for high tension tests of thin samples. This arrangement is recommended as it permits a gradual increase of potential.

As many samples of the same material give widely different results, a large number of samples should be tested and an average taken after discarding the samples which give exceedingly low values; such low values may be due to small pin-holes.

Dielectric Capacity is the property of insulating materials to store up an electric charge in a medium between two conductors and is generally stated in microfarads or fractions thereof.

When the capacity is relatively large 0.5 mfd. or more, the measurement is generally made by the direct deflection method, however some engineers prefer the so-called loss of charge method.

The arrangement for the first method is shown in Fig. 5. A ballistic

galvanometer "G" is used. The slider is adjusted first for one condenser and then the other to be certain that when the key is depressed and released, the pointer does not swing off the scale. The greatest accuracy

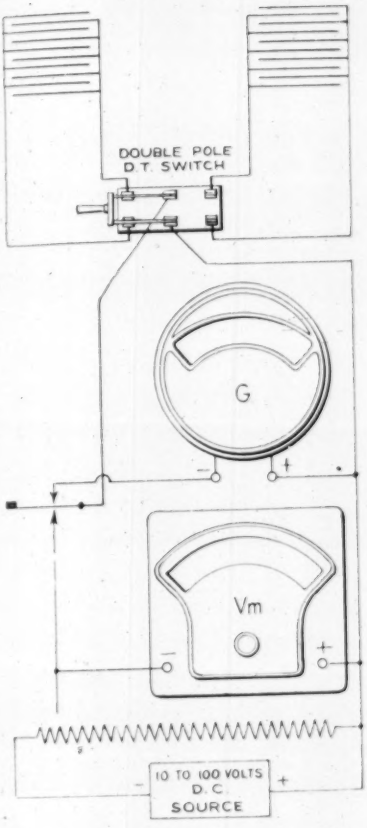


Fig. 5. Measurement of Dielectric Capacity by deflection method.

is obtained when the capacities of the two condensers are almost equal

The method of operation is as follows: with the switch thrown to the right, the key is depressed and held down. The key is then released and this cycle is repeated several times to be certain that the condenser is fully charged. Upon releasing the key the swing of the pointer is noted, and also the potential as indicated by the voltmeter "Vm." The switch is then thrown to the left or standard condenser, the key is then operated as before, at the same time changing the position of "p" until a deflection of nearly the same value is obtained on the galvanometer, the capacity can then be obtained from the following:

$$\frac{d}{d_1} = \frac{CE}{C_1E_1}$$

where d is the first deflection and d_1 the standard deflection

where E is the first potential and E_1 the standard potential
where C is the first capacity and C_1 the standard capacity

Or where great accuracy is not desired, a potential is adjusted by moving "p" so that the swing or deflection with both condensers, while not equal in each case is easily read: then

$$\frac{d}{d_1} = \frac{C}{C_1}$$

The ballistic galvometer or voltmeter used should have a resistance of at least 300 ohms per volt.

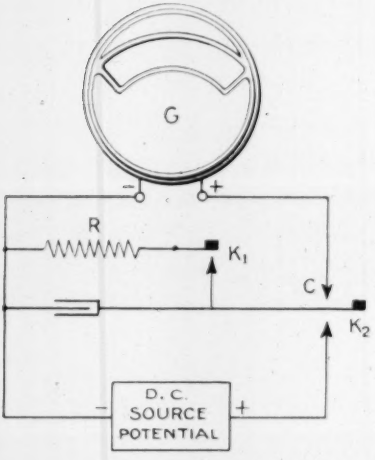


Fig. 6. Measurement of Dielectric Capacity by loss of charge method

The loss of charge method is only accurate when the resistance of the dielectric is high, the measurement being made as follows: "G" is a voltmeter or ballistic galvometer of more than 300 ohms per volt; "R" is a known high resistance, and as the D.C. source a storage battery of more than 20 volts is used. K_2 is depressed and released and the deflection noted. K_2 is again depressed and released but not allowed to contact at "c" until K_1 has been closed a definite measured time and a new reading obtained—then

$$C = \frac{t}{2.303\ R \cdot \log_{10} \frac{d_1}{d_2}}$$

where c = capacity in mfd.
R = resistance of R (Fig. 6) in ohms
d_1 = first deflection
d_2 = second deflection
t = time K_1 is closed in seconds

As the accurate measurement of extremely small capacities is rather difficult and of little value to the engineer except in very special cases, such as tests of cables in ducts, it will not be taken up here.

(Continued in the March Issue.)

Measuring to Four Parts In a Billion

By P. P. Cioffi*

RESEARCH problems sometimes require the measurement of small displacements. For those approaching the order of one part in 100,000 simple and direct methods of measurement can no longer be applied and recourse must be had to various artifices. In a problem bearing on the physical nature of permalloy it was desired, in detecting changes of length, to extend the lower limit of measurement to a few parts in 1,000,000,000.

The actual accomplishment, measuring to four parts in a billion, resulted from the development of a new method of measuring increments of length which is more sensitive and more accurate than any used heretofore.

Since 1847 it has been known that magnetic substances change their dimensions with magnetization. This phenomenon called magnetostriction, was also early recognized as highly significant in explaining certain ferromagnetic phenomena. On the other hand within our laboratories experiments on the effect of tension on the magnetic behavior of long thin rods had confirmed the existence of a critical composition of nickel-iron alloy which has no magnetostriction. This led L. W. McKeehan to formulate his atomic theory of magnetostriction which relates the properties of permalloy to its magnetostrictive behavior.[1]

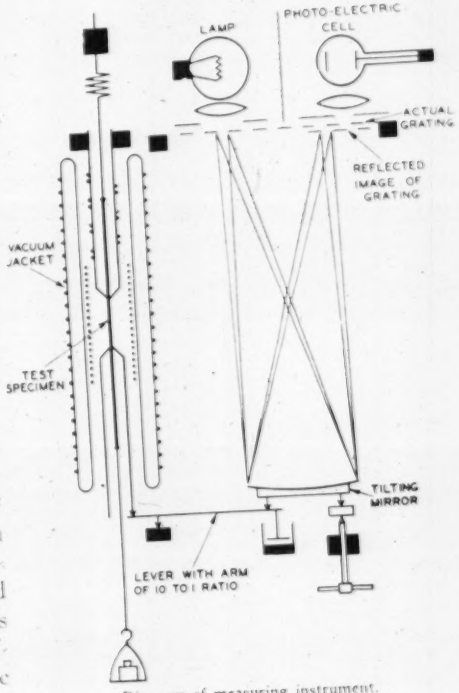


Diagram of measuring instrument.

Fig. 1

To test the theory there were required measurements of magnetostriction, at low magnetizations, in iron, nickel and permalloy. Rela

1 Bell Laboratories Record, Dec. 1926, p. 105.

*Bell Telephone Laboratories, Incorporated

tively large magnetostrictive effects represent only exceedingly small changes in length. To be able, therefore, to detect such effects in the case of permalloy where it is very much smaller there is required a method of determining, in a centimeter of length, a change of the order of one-tenth of the diameter of an atom.

Apparatus and Method of Measurement

The principal parts of the apparatus are shown schematically in Fig. 1, which is distorted in order to show with equal clearness parts differing widely in dimensions. The wire under test was about 1 mm in diameter and 40 cm in length. It was hung vertically from a helical spring and was stretched, when desired, by loading its lower end. Magnetic fields were applied by passing currents through one or both of the two windings (No. 16 enameled wire) of a solenoid, 52 cm long and 3.1 cm in average diameter, coaxial with the sample and wound on the outside of a tubular glass jacket with two walls. These walls were silvered and the space between them was evacuated to reduce the radial flow of heat. The inside diameter of the jacket was 1.3 cm.

One of the windings of the solenoid was used for demagnetizing the specimen before each measurement of magnetization and magnetostriction.

The part of the wire in which the magnetostriction was measured was the middle 12 cm of its length. This was clamped at the top to the lower end of a rigidly supported brass sleeve and at the bottom to the upper end of a similar sleeve, the lower end of which projected from the magnetizing coil and rested on the shorter arm of a duralumin lever. The upper sleeve was 24 cm long, the lower, 21.5 cm. Both were of 1.6 mm inside, and 3.2 mm outside diameter, and were clamped onto the wire by small three jawed brass chucks of the same outside diameter. The sleeves were slit longitudinally to reduce eddy currents. The upper sleeve was not fixed to its brass support until the wire and its supporting spring had been stretched by any applied load. (The weight of the lower sleeve was balanced by the lever.) The helical spring then ensured that magnetostrictive strains in the upper part of the wire did not create appreciable differences in tension within it above and below the plane of attachment of the upper chuck.

The duralumin lever was 22 cm long and its arm had the ratio 1:10. Its cross-section was rectangular, of width 3 mm and of height tapering from 5 mm to 2 mm. The lever rocked on an agate knife-edge, 2 cm long, resting on an agate plate. Its long arm had cemented on its top a slip of glass on which rested the free foot of an optical lever. It also carried, for mechanical damping, a plunger traveling freely in a dash-pot that could be filled with oil when especially sudden displacements were to be measured. Magnetostrictive displacements did not

generally require the use of this dash pot. The other two feet of the optical lever, on a line 0.794 cm from the free foot, rested in small glass cups on a brass arm which could be bent slightly by a stout screw in a more rigid member so as to adjust the height of the axis of tilt. One of the cups was set in the end of a set screw to permit leveling this axis.

The optical lever carried upon its nearly horizontal upper surface a selected concave mirror, 1.3 cm in diameter and with a radius of curvature of 1 meter, front-silvered in vacuum by evaporation. The mirror was stabilized by grinding the metal support to fit its back. A glass screen on which black lines 0.0508 cm wide were accurately engraved 0.0508 cm apart, was set horizontally one meter above the mirror and with its lines parallel to the axis of tilt. A small lens condensed the light, from a 14-volt gas-filled incandescent lamp with coiled tungsten filament upon the screen so as to cover a circle about 1.5 cm in diameter and to form an image of the filament on the concave mirror. The mirror was then adjusted to project an image of the illuminated part of the screen onto an otherwise unilluminated part of the same screen. A lens set just above this image collected the transmitted light into a photoelectric cell connected through a dry-cell battery (70 volts) to a galvanometer. The tilting of the optical lever caused the bright stripes of the image to travel across the equally-spaced transparent stripes of the screen. The change in the transmitted light was nearly proportional to the change in length of the section of wire between the two sleeves.

The galvanometer (period on open circuit 7 sec.) in series with the photoelectric cell was critically damped and adjusted to give a deflection of about 50 cm (at a distance of 120 cm) for the change from full transmission to full cut-off. An iris diaphram on the collecting system was used for this adjustment, its normal opening being such that the maximum transmission was practically independent of image position over a wide range. The lamp, operated on portable storage batteries, without a series resistance, gave a sufficiently steady source of light. Under these conditions 1 mm on the scale of the galvanometer corresponded roughly to a total change in length of the object, in this case 12 cm of wire, of 4×10^{-8} cm. For changes in length greater than about 2×10^{-5} cm account had to be taken of the opposite variation of galvanometer deflection and length during successive half-millimeters of the motion of the image on the screen. Changes in length greater than about 4×10^{-4} cm caused such large displacements of the image that the photoelectric cell ceased properly to integrate the transmitted light, but this limit was not exceeded in the final measurements. The multiple slit and photoelectric integrater are similar in principle to an arrangement used by Rankin[2] for detecting rapid vibrations. Their use in the manner here described has the effect of giving to the length

[2] Rankine, A. O. Proc. Phys. Soc. 31, 242-264 (1919).

measuring galvanometer a nearly uniform scale, some 10 meters long, folded into a space of less than 50 cm.

The length-measuring galvanometer was calibrated by propping up the long arm of the duralumin lever at a point a few centimeters from its bearing, and then allowing a succession of drops of oil, fed under constant pressure through a small nozzle, to fall into a pan so hung as to bend the free end of the lever. The interval between drops was so adjusted that the galvanometer index came to rest in each interval, permitting accurate reading of its position on the scale. The drops being of equal weight, and the greatest stress in the lever being well within its elastic limit, it could safely be assumed that the consecutive positions of the image on the screen (about 2×10^{-3} cm apart) were equally spaced. A representative calibration curve, obtained in this way, is shown in Fig. 2. The points are plotted as read, without any sort of smoothing. Along the upper edge of Fig. 2 four diagrams are placed which show how the image, as seen from the upper side of the screen, travels across the field of the photo-electric cell (the smaller circle of the diagram) as the lever is bent. The diagrams correspond to the points on the calibration curve directly beneath them, but the number of stripes in the image has been reduced to make the changes in its appearance more conspicuous. The background, consisting of both opaque and transparent stripes, is shown in these diagrams.

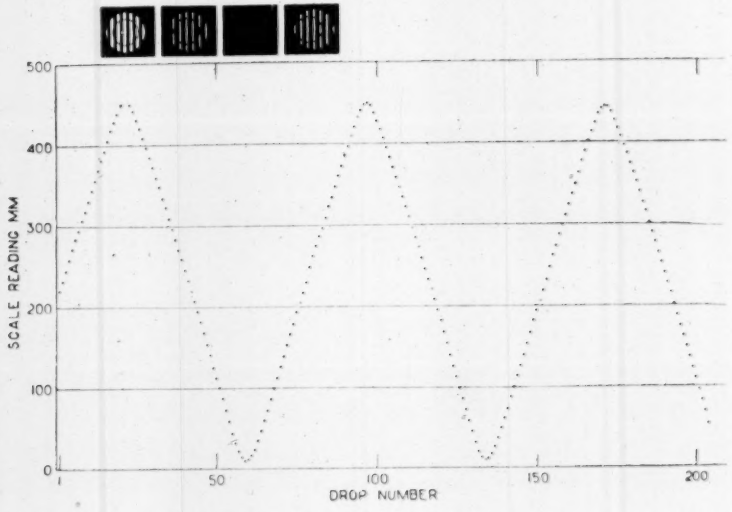


Fig. 2. Representative calibration curve.

The relation between image position and reading on the galvanometer scale is nearly enough linear over about 85 percent of the total range on the scale, but optical defects cause a deviation from linearity near the positions corresponding to greatest and least transmission

This could be taken into account in the interpretation of scale readings in the affected regions, but it was better to avoid such readings by a method to be described below.

Since heat is generated in the wire and its attachments by the eddy currents set up during changes in magnetization and since a rise of temperature of only 0.001° C causes thermal expansion (in the 12 cm of wire alone) sufficient to change the galvanometer reading by about 50 mm, the drift due to imperfect thermal equilibrium within the nearly heat-tight enclosure would have been troublesome. To eliminate drift, a non-inductive winding was imbedded in the upper brass sleeve, and such a current—a few milli-amperes—was passed through this winding, that its equilibrium temperature was raised a few hundredths of a degree. This current was then regulated, just before reading, until the drift was compensated.

This process was made nearly instantaneous by reducing the thermal capacity of the sleeve and its winding to the smallest practicable value. In the absence of magnetic changes it was possible in this way for a practiced observer to keeep the galvanometer index steady within range of one millimeter as long as desired and deflections could be taken from a zero chosen, for greater accuracy so that both the initial and final readings fell within the linear part of the scale. The same artifice made it convenient to check the constancy of the maximum photoelectric current, i.e., the constancy of the lamp and photoelectric cell, before each reading, by varying the length of the system slowly through a value corresponding to maximum galvanometer deflection (upper turning-point). The sign of a change in length was determined by noting in which direction an increase in the drift-correcting current corresponding to increase in length moved the galvanometer index. The number of maxima and minima traversed in a large change in length was sometimes checked by making the change in applied field take place so slowly that the galvanometer had time to go through the successive turning-points. In all cases where the initial and final readings lay between different pairs of turning-points the upper turning-point was determined after, as well as before, the deflection occurred. The lower turning-point, it should be noted, was practically independent of the state of the optical and photoelectric systems.

Summary

The magnetostriction which was measured was that occurring in the middle portion of the specimen under examination. The specimen was in the form of a wire and the portion measured was that between a rigidly supported upper sleeve and a lower sleeve which rested upon the short arm of a lever. The long arm of this lever actuated another lever which tilted the mirror.

When magetostriction changes the length of the specimen and the mirror tilts, the galvanometer reading changes. If, for example, at the

start there is no current because the image of the slits coincide with the opaque stripes, of the screen, then the current and galvanometer reading increase to maximum, and then decrease to zero when such coincidence again occurs.

As the length continues to change this cycle repeats; and the observer knows the whole number of spaces on the screen over which the mirror image has been shifted from his count of the number of times the galvanometer has swung back to its zero. The fraction of a space is determined by the galvanometer reading: this could be read to one-tenth of a centimeter on a scale one meter away from its mirror. And that deflection corresponded to a magnetostrictive displacement of about four billionths of a centimeter for each of the ten centimeters of length of specimen between the clamping sleeves.

So sensitive a system necessitated complete protection from building vibrations. The apparatus was accordingly mounted on a heavy plank and the whole was supported upright on a Julius suspension of damped springs. Thermal changes were also to be avoided. These arose from the magnetizing winding surrounding the wire. The effects were considerably reduced by jacketing the solenoid with a vacuum as shown in Fig. 1. This, however, did not result in constant temperature within the solenoid and an additional non-magnetizing winding was imbedded in the upper sleeve. Current was also supplied to this winding so that the heating of the specimen was due to both magnetizing and non-magnetizing windings. This made the wire slightly hotter than it would otherwise have been but its temperature could be maintained by small adjustments of the current through the auxiliary, or heater, winding. The natural drift in equilibrium temperature within the solenoid was thus very closely compensated.

::

Peter von Musschenbroek's pyrometer was constructed in 1731. It was so made as to utilize the expansion of a metallic rod to measure the temperature to which the rod was exposed.

::

Rene Antoine de Réaumur, 1731, famous French chemist, invented his thermometer scale, "taking the freezing point of water as zero and graduating the tube in degrees, each of which was 1/1000 of the volume contained by the bulb and tube up to the zero mark." The boiling point of water was designated as 80°.

::

Prof. W. F. Barrett of the Royal College of Science, Dublin, first observed that iron and steel on cooling down from a white heat suddenly became hotter at a definite point, owing to an internal molecular change. He named the phenomenon "recalescence." It was soon afterwards discovered that the hardening of steel was closely connected with this phenomenon. Barrett's experiments on this were conducted in Professor Guthrie's laboratory at South Kensington, London. The demand for accurate pyrometers followed immediately on these discoveries.

The New Improved Type of Brady B.T.U. Indicator

By R. A. Malony*

EIGHT years ago, at the first American Gas Association Convention, an instrument for indicating the heating value of gases directly in B.t.u. per cubic foot was described by E. J. Brady, Manager of this Physical Laboratory of The U. G. I. Contracting Company, and for which he was awarded the Beal Medal.

The Indicator filled the long-felt need for a method of obtaining a quick B.t.u. reading, which could be made by a person having no technical experience. A complete determination of the heating value of a gas can be made with it in two minutes. This, together with the fact that it is portable and does not require a source of running water with an overhead tank, as is the case with a flow calorimeter, probably led to the present popularity of the instrument.

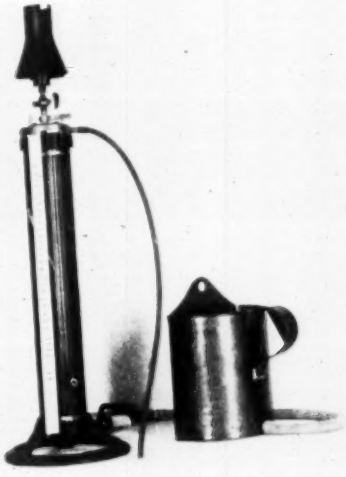


Fig. 1. The Complete Apparatus

Many companies maintain a B.t.u. Indicator on the operating floor of their water gas plants. This enables the gas maker to control his oil input with considerable accuracy.

Its portability has also proven a useful feature, as it can be carried about as easily as an Orsat apparatus. Thus, in the case of a coal gas plant, the heating value of the gas coming from any retort can be taken at any time during the charge, furnishing a source of information impossible to obtain in the past, except by the long process of gas analysis.

An instrument of this type located in the superintendent's office permits a quick check of the heating value to be made at any time.

The instrument is not unsightly and occupies little space, and in one case the manager of a small gas plant maintains an indicator at his home, to test the quality of the gas being sent out. As he, himself, expressed it, "Every night, I read the B.t.u. Indicator, say my prayers and go to bed." We judge the prayer depends upon the B.t.u.

*Physical Laboratory, The U. G. I. Contracting Company

Top View

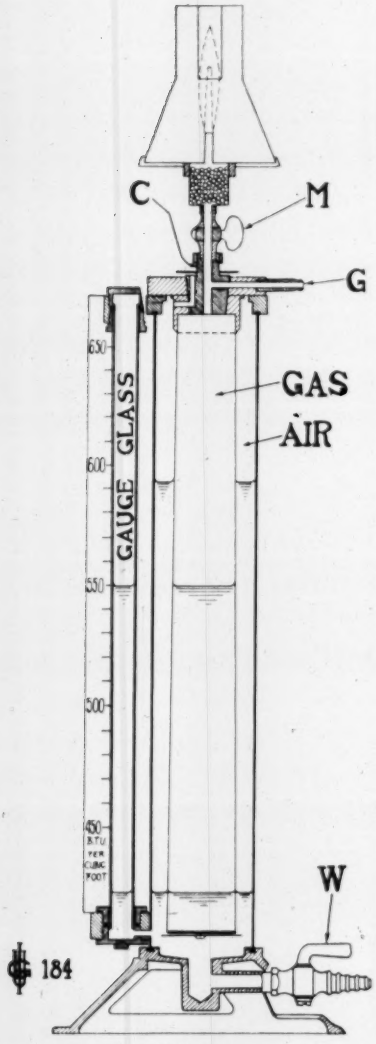


Fig. 2

Another application for it is in the Distribution Department. The Indicator not only furnishes the heating value of a gas, but it also illustrates exactly the phenomenon that takes place in the flame or burner of the customers' appliances. The modern trend toward mixing gases of different characteristics will undoubtedly lead to the necessity of making a careful survey of the character of the gas throughout the distribution system to anticipate any customer complaints. The importance of this factor is clearly brought out in the extensive series of tests now being conducted at the American Gas Association's Cleveland Laboratory, on the mixing of gases.

Figure No. 1 illustrates the complete apparatus, and Figure No. 2 shows the instrument, itself, in detail.

The principle is based on the fact that a simple relation exists between the total heating value of a gas and the amount of air necessary to form the well defined blue inner cone of a Bunsen burner flame. This principle is utilized in the Brady B.t.u. Indicator by causing the gas-air ratio to gradually change and pass through the point at which the inner blue cone becomes well defined. The change in the gas-air volume is brought about by rising water observable through the gauge glass and it is not necessary for the operator to know these volumes. These volumes are taken into consideration in the calibration of the instrument, and from the principle involved the ratio of the gas and air volumes may

be plotted to read directly in B.t.u. per cubic foot. The readings are independent of room temperature, humidity of the atmosphere and barometric pressure. The many other corrections necessary to apply to the standard flow calorimeter readings are also unnecessary, rendering the instrument much less liable to the personal errors of the operator.

General Description of Instruments

From Figures No. 1 and No. 2 it is seen that the Indicator consists essentially of a vertical brass cylinder three inches in diameter and seventeen inches long, to which is attached a base and top casting. There is a slightly tapering cone of thin metal screwed into the top casting and concentric with the outside brass tube. This cone forms the gas chamber, and the annular space between it and the outside brass cylinder forms the air chamber. Attached to the side of the instrument is a gauge glass for observing the height of the water in the gas space during filling, and the height of the water when the determination is completed, which height gives the gas-air ratio at that point, or, as explained above, gives the approximate heating value of the gas on the attached scale. The air and gas are admitted, and the two chambers connected and separated by the main cock at the top.

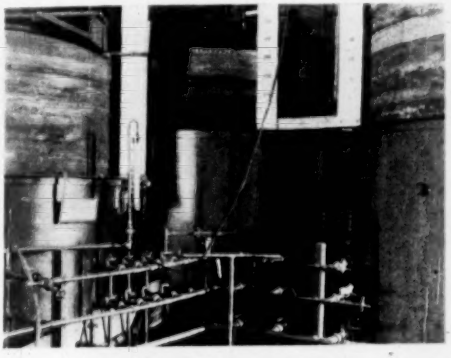


Fig 3. Laboratory gas holders used for preparing sample mixtures.

Operation of B.t.u. Indicator

The air from the room and the gas to be tested are drawn into the instrument by the lowering of the water level, and expelled by the raising of the water level. The aspirator, shown in Figure No. 1, attached by a hose to the Indicator, furnishes the means of changing the water level. The gas is drawn into the center cone, and the air drawn into the outer space simultaneously. The pressure of the gas in the instrument is then reduced to atmospheric by allowing the excess gas to escape. The air and gas, being at the same pressure, are connected at the top and expelled as an air and gas mixture through the mixing chamber to the burner, where the mixture is ignited.

The water as it ascends is at the same level in both air and the gas chambers, and can be seen in the gauge glass. As the gas cone is slightly tapered, the gas percentage in the mixture is constantly decreasing, and

the air percentage constantly increasing. This produces a change in the resulting flame. The luminosity gradually decreases, and the outline of the blue inner cone begins to form. At the instant the tip of the inner cone forms a definite line the water is shut off at cock "W" (Figure No. 2), and the approximate heating value read on the scale opposite to the stationary height of the water in the gauge glass.

New Features

In the older type of instrument the three-inch outside tube surrounding the air space was made of glass. The rise and fall of the water level in the air space could then be observed directly. The breakage of these glass tubes was the chief objection to this type of Indicator, as it was necessary on replacing a glass tube to completely recalibrate the instrument and make a new scale. This was made necessary by the inherent irregularities in the inside diameters of the glass cylinders. It was impossible to obtain on the market any glass cylinders as large as three inches in diameter, having the accuracy required. It can readily be seen that, in replacing a glass cylinder, a change in the inside diameter would change the volume of the air space, thus upsetting the existing gas to air ratio. Another difficulty experienced with the glass tube was the discoloration of the inside surface with continued use. To clean this glass it was necessary to dismantle the instrument, using extreme care not to break the glass, especially after the rubber gaskets at each end had become vulcanized to it.

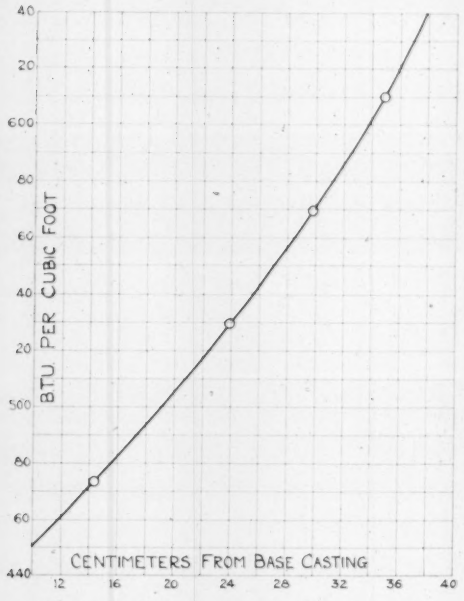


Fig. 4. Calibration curve used to construct heating value scale.

In the latest type of instrument the glass tube has been replaced by an accurate seamless drawn brass tube. A gauge glass mounted on the side is connected at the top to the gas chamber, and at the bottom to the common water space. This indicates the water level in the gas compartment at all times, and accomplishes the same purpose, of observing the water level, as the former three-inch glass cylinder. If broken, the gauge

glass can be replaced in a few minutes with another of the same size, so that the calibration of the instrument is not affected. The gauge glass is a section of standard 3/8-inch gauge glass, such as might be carried in stock by any gas company. It is also readily accessible for cleaning without removing from the instrument, should it become discolored on the inside. The operation of the apparatus has been further simplified by combining the air and gas inlet cocks with the mixing cock, forming a large four-way cock. Four cocks on the top casting of the old type Indicator were thus reduced to two on the new type.

The multiple cock is constructed so that an audible click indicates the proper position of the handle for each operation. The four positions of this cock are shown in the top view of Figure No. 2. The positions occur in sequence from left to right for the proper operation of the Indicator.

The finish of the instrument has been changed from polished nickel plate to a black mottled finish. Experience has shown that a finish of this type is much better suited to resist the corroding atmosphere prevalent in most gas works.

The manner of fastening the scale to the instrument has been changed, so that there is no possibility of shifting its proper position.

Calibration

In calibrating, a relation is established between the stopping point of the water on four different samples of gases. The heating value of these gas samples is obtained on a standard flow calorimeter, using the method with all the corrections recommended by the United States Bureau of Standards in Circular No. 48 (Standard Methods of Gas Testing). From this data a curve is drawn, as shown in Fig. 4 and a scale constructed, which will then indicate the heating value at any point within the range of the instrument.

A mixture of blue gas and oil gas is used as the calibrating gas. It has been found by experiment that a gas of this nature and a carburetted water gas, both having the same heating value, give identical readings on the B.t.u. Indicator.

The gas samples are prepared in the center holder, illustrated in Figure 3. A blue gas, manufactured on the Physical Laboratory blue gas set, is stored in the holder on the right, and an oil gas in the left-hand holder. These gases are proportioned in the middle holder to give the desired heating value. A gas pump continually stirs the calibrating gas, insuring a uniform mixture.

Contents of Subsequent Issues

Historical Sketches of Men who have contributed to the advancement of the Instrument Science.
Temperature control in Process Industries.
Correct Connections for Polyphase Watt Meters.
Humidity Test Equipment.
The Measurement of High Temperature by Radiation Pyrometers.
Modern Precision Measuring Tools for Machine Shop Use.
Aeronautical Instruments.
The History of the Electric Meter.
Organization in Research.
Weighing Devices.
Conservation through Metering.
The Measurement of Illumination.
Flow Measurement.
Automatic Combustion Control.
Optical Pyrometry.
Thermometry.
The Importance of Measurements in the Power Plant.
The Care of Measuring Instruments.
Equipment Used in Aerial Surveying.
Automatic Control of High Temperatures.
The Measurement of Boiler Combustion Zone Temperatures.
Fluid Meters.
Instruments for Geodetic Prospecting.
Dilatometry.
The Measurement of Pressure.
Speed Recording Instruments
Engine Indicators.
Instruments applied to the Open Hearth for Efficiency.
Thermoradiometers.
Mechanical Vibrations and Their Measurement.
Instruments to improve Diesel Engine Efficiency.
Comparison of Instruments for Measuring Hardness.

The Measurement of Luster

By Dr. W. Ewald, Berlin, Germany

THE usefulness and therefore at the same time the value of different materials (textiles, papers, metals, lacquers, paints, etc.) are on the one hand dependent upon the structure, and on the other upon the condition of the surface, which can be totally different with the same structure. That the numerical determination of the degree of luster seems to be of considerable importance, can be gathered from the fact, that a number of instruments exist, which already have been introduced into control laboratories and which permit the measurement of the surface luster. Naturally the scales of the various instrument types differ considerably and up to the present it has not been possible to create a universally absolute luster scale. To be sure it must be admitted, that the luster measurements which have been made denote a certain advance, as they have in part replaced the purely subjective methods. In this article a new definition of a luster scale is given, which, the author hopes will find general adoption. The instrument described below has found extensive use also outside of Germany. As proven by a large number of impartial tests, a division into classes, for example of papers, cloths and lacquers, etc., is possible. It can also be mentioned that the German Standards Committee in Standard Specification No. 1841 on color and luster value of a lacquer sample, specifies that the luster value be 8, as determined by this instrument.

With all previous luster measuring instruments, the light from a limited light source is thrown upon the object to be examined with a comparatively large angle and either the distribution of intensity or the polarization condition of the reflected light is determined. The theory and construction of the available luster meters is described in detail in various papers[1], so that the details will not be repeated here.

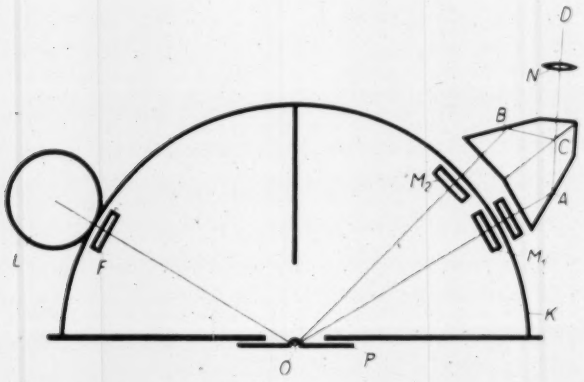
As has been mentioned above, certain difficulties arise in practice, due to the fact that a universal luster scale is not available, even though the luster of itself has physically a well defined meaning. With the conversion of the various scales existing today into one another care must be taken, that with the various constructions, different directions are used for the light rays and also for observation, and that a conversion is only possible under the assumption of fully equivalent reflection. The author does not want to discuss in greater detail the different light and observation angles. Schulz and Pokrowski have set

1 K. Kieser, Zeitschrift fuer angewante Chemie 32, 357, 1919; Comment 56, 275, 1919.
L. A. Ingersoll, Journal of the Optical Society, 5, 213, 1921.
A. Douglas, Melliand's Textilberichte 2, 411, 1921.
H. Schulz, Melliand's Textilberichte 5, 25, 1924.
A very complete presentation is given by H. Schulz, Zeitschrift fuer technische Physik 5, 135, 1924.

up emperical laws for the reflection from partially light dispersing surfaces, the detailed discussion of which alone will take up a small book.

The author will attempt to briefly illustrate the principle of this new instrument and in conclusion offer the definition of a new luster scale.

As it is not permissible to vary the light and observation angles for different observations, the construction of the new luster measuring instrument is carried out according to the illustration.



In a well ventilated metal housing L is placed the light source, which gives a uniformly bright light, easily controlled by means of diaphragms. As with the testing of bodies of different color, color differences can easily occur in the field of view of the luster meter, in that case, color filter F can be placed in the path of the light rays. The sample P to be examined is placed below the lower plate of the instrument, which serves to carry the lamp housing and the observation piece. The lamp L as well as the observation piece, can be turned about O. The observation arrangement permits the comparison of two light bundles, which make an angle of 15 degrees with one another (OB and OA). By means of a photometric comparison arrangement it is possible to compare the brightness of these two bundles of light rays. The weakening of the one ray is a measure of the luster value. For observation the ocular N permits a sharp setting of the division line C of the field of view. M_1 and M_2 are absorption plates and wedges of the photometric arrangement. The semicylindrical part K in addition carries diaphragm screens, which will not be described further.

Naturally for practical measurements one always strives to be able to determine the desired value, namely the luster value by a single setting of the light L and the observation part. For papers, cloths, metals and lacquers, one has been able to accomplish this. One there works with a single setting of the lamp, and in fact with an angle of incidence of 45 degrees. By making the light source and the observation part of

the instrument adjustable, it became possible to increase the measuring range considerably, and also to carry out the most varied scientific investigations.

The new luster meter, whose measuring range goes from 0, the luster of a rough gypsum surface, to the luster value 100 (the luster of total reflection) is at the present the most extensive instrument of its type. The possibility of carrying out the different combinations of incidence and observation arrangement are not possible with the half shadow photometer of Ostwald or the Goerz luster meter and these must therefore be designated as being somewhat limited. Therewith it is not intended to convey the idea, that these instruments, in spite of this limitation to a fixed incident and observation direction, are not satisfactory for the comparison of surface properties of certain classes of materials.

Definition of Luster Value

With the luster scales used up to the present time, it is always assumed, that the regularly reflected light superposes the diffuse reflected only in the reflection direction, and according to this the luster value is always given as the relation of the regularly reflected to the diffuse reflected, in so far as arbitrary scales have not been used as a basis, which naturally is also satisfactory for comparison measurements. If one desires to compare the existing luster scales with one another, there results, as has already been stated above, a difficulty, as the relation in the case of totally diffused reflecting surfaces is 0, in the case of ideal mirror ∞. This scale also has the difficulty, that increasing the reflected light from 1 to 2 with heavy diffusion only effects a slight change, while with mirror surfaces the increase from 1 to 2 for the regularly reflected light has a very decided influence. It therefore is better to define the luster value as the percent of the regularly reflected light in relation to the total intensity thrown back. In this case the value for a wholly diffuse reflecting surface (rough gypsum surface), is 0, for a totally regularly reflecting surface (total reflection), the value 100. This scale is the one used in the new luster meter.

The necessity for the measurement of luster is evident, as it is desirable to reproduce the surface properties of certain bodies within very narrow limits (paper, rolled metals, woven fabrics, lacquers, etc.). The luster value is of especial importance for materials used for decorative effects. Even the architect can duplicate luster values previously determined with the luster meter. The experience has been that the field of usefulness of the instrument is very large.

Information Section

Correspondence from instrument users and others pertaining to or relative to instruments

THIS section invites correspondence from instrument users and others relative to questions pertaining to instruments. If our own editorial staff should feel that any question submitted cannot be readily answered, we will obtain the necessary information from some of our collaborators. Thus the greatest experts are at the disposal of our readers in assisting them in the solution of their instrument problems.

Names and addresses of manufacturers of instruments will be furnished on special request. Inquiries pertaining to sources of supply should be addressed in writing to our Information Section. Such inquiries will be answered promptly by mail.

Inquiries regarding instrument problems will be answered by publication in this special "Information Section" of INSTRUMENTS. We feel that other besides the inquirers may be interested in the same or similar problems, and in this way all of our readers will obtain the benefit of the information furnished.

No. 1. We are at the present time looking for an instrument for detecting noises in ball bearings. We are wondering if you have any information in your files about concerns which make instruments, which could be used on a production basis, for detecting noises in bearings?—V. W. F.

No. 2. Can you put us into communication with the manufacturers of the Howard-Dolman Depth Measurement Instrument?—E. F. H.

No. 3. Where could we get in touch with different manufacturers of colorimeters, or instruments for determining the brightness and color of pigments such as dry zinc oxide, white lead, etc.?—J. L. G.

No. 4. Could you give us the names of manufacturers of small permanent magnets for special applications?—G. H. C.

No. 5. Please furnish information on electric ignition for natural and artificial gas.—G. H. C.

No. 6. Please furnish us the names of manufacturers of Indicating Draft Gauges.—F. A. T.

No. 7. Could you give us the names of manufacturers of Paper Testing Apparatus?—S. C. L.

No. 8. Can you give us the name of any concern that could supply us with a jump spark coil that would give a spark 24 inches long? The coil should operate on a storage battery with six or twelve volts.—A.A.D.

New Instruments

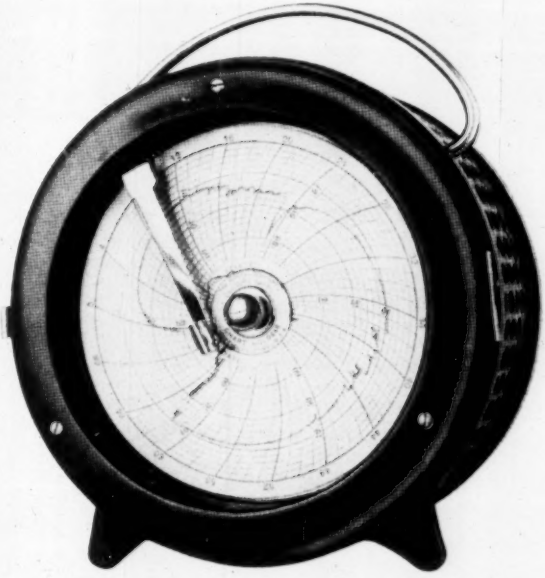
Recently Developed by Instrument Manufacturers

Portable Recording Thermometer

(Bristol Company)

OF unusual interest to users of recording thermometers will be the latest addition to the "Bristol's" line.

The new Model of Bristol's Recording Thermometer shown in the illustration is smaller than any previously offered. It uses a 4 inch chart only, as compared to 6, 8, 10 and 12 inch on other models, thus permitting the use of a reliable recording thermometer in many important locations.



This illustration is less than half-size; the approximate diameter of case is 6 inches.

This Model 144 Recording Thermometer is particularly suitable for an efficient check of atmospheric temperature conditions in such places —Cold Storage Rooms, Electrical Refrigerating Units, Dairies, Greenhouses, Dwelling Houses, Schools, Hotels, Theaters, etc.

The records are continuous for a period of 72 hours or 3 days, during which time the instrument requires no attention whatsoever.

The measuring element consists of a bi-metallic helix which is positive in operation and extremely sensitive to temperature changes. The penarm is attached to the measuring element and records directly on the chart without the aid of any intervening or complicated multiplying devices.

A special frictionless form of inverted penarm with fountain pen is part of the standard equipment furnished with Model 144 Recording Thermometer. This insures a sufficient supply of ink and a uniform record line for the complete 72 hour revolution of chart.

The clock is an especially designed "Seth Thomas" make, having all parts plated with a rust-proof preparation to safeguard against any possible action of moisture. The clock key is permanently attached to back of instrument case so that the clock may be readily wound without removing the chart or interfering in any way with continuous operation of recorder.

The Thermometer is easy to install. It is entirely self-contained and is simply placed wherever temperature readings are desired, without the necessity of running leads or any form of connection.

Chart Ranges Available

25 to 125° F.—Recommended for recording Greenhouse temperatures, etc.

50 to 90° F.—Recommended for recording temperature in dwellings, hotels, apartment houses, theaters, schools, etc.

30 to 70° F. (Reverse Scale)—Recommended for recording refrigerator food chamber temperatures.

20° to plus 80° F. (Reverse Scale)—Recommended for recording ice-cream hardening temperatures, cold box, etc.

The Hammer-Fennel Tacheometer Model 1927

(*Otto Fennel Sons*)

THE demand for a comparatively small, light instrument for stadia measurements, with which one can determine quickly horizontal distances, elevations and horizontal angles without complicated calculations and tables, was met by the Hammer-Fennel Tacheometer, Model 1927.

This instrument is similar in its outer form to a solidly built repetition-theodolite without the vertical circle. It has a telescope of special construction, which cannot be reversed (see Fig. 1).

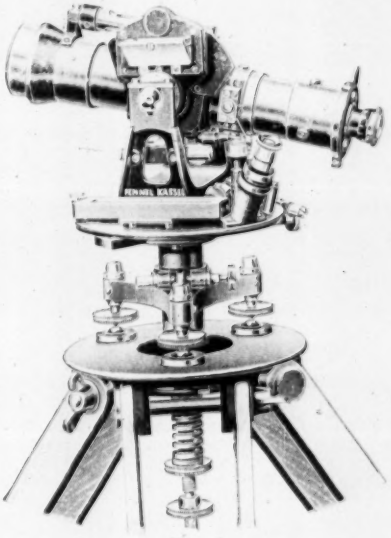


Fig. 1

In aiming it at the stadia pole, one sees in the telescope — in the left half of the field of view — a diagram, whose lines shift themselves in the horizontal direction with each vertical movement of the telescope. After setting the zero curve on the zero mark of the pole on which one sights, one reads off two values where the diagram lines cut the divisions of the pole. First the distance number, which is multiplied by 100 and second the elevation value, which is multiplied by 20 and gives the difference in elevation between the point at the foot of the stadia pole and the instrument station, without the necessity of a further calculation, diagram or table.

Fig. 2

Fig. 2 illustrates an example, with which the following results are obtained: 0.215 x 100 = 21.5 meters horizontal distance and + 0.241 x 20 = + 4.82 meters difference in elevation. The elevation curve shows the + signs, if the line of sight rises above the horizontal and the — sign, if below. The construction permits an inclination of ± 30°.

The horizontal angles are read on the small microscope, which is fastened beside

the ocular of the telescope, so that all the readings can be made without the observer changing his position. The divisions are made on solid silver, either in 1/6° in the sexagesimal system (360°) or in 1/10° in the centesimal system (400°). Each full degree is numbered and one can estimate the minutes with ease. See Fig. 3, reading 124° 35′.

The instrument is supplied with one level on the telescope and 2 levels on the vernier plate. A trough compass is attached on the side of the telescope bracket. The tripod with the metal head and the mahogany carrying case with leather strap are in keeping with the first class workmanship of the instrument.

Fig. 3

In many cases the time required for a reading is one-half that required for making a reading with a circle tacheometer. The accuracy obtained with this instrument lies within the limits required for topographical measurement.

The Hammer-Fennel Tacheometer, Model 1927, has in comparison with the Model 1900, which was built until now, the big advantage that its outer dimensions and therewith its weight has been considerably diminished. This reduction can best be seen from the fact that the case for the instrument has now only 50% of its former volume. Its dimensions are now 30x20x28 cm.

The telescope is furnished with an inner focussing lens and is totally water and dust proof. The focussing of objects at various distances being accomplished by the movement of a lens along the optical axis by means of an improved mechanical system.

Tag Steam Operated Controller

(C. J. Tagliabue Manufacturing Co.)

THE TAG Steam-Operated Controller is simply a device which utilizes a portion of the steam which heats an apparatus to obtain enough power to work the valve, the opening and closing of which governs the temperature of the apparatus where One Best Temperature must be maintained.

Power is obtained without waste from the pressure of the steam. Variations in this pressure do not affect the accuracy of control, for the reason that it is not the entire pressure, but a differential pressure above and below a diaphragm, which is thus utilized.

By referring to figures 1 or 2 you will note that steam is always permitted to enter the diaphragm chamber through opening C whether the steam valve is open or shut. Also, note that there is an opening B which connects the space above the diaphragm with the space below it. Steam can flow through this opening. If it is not allowed to escape at all from the upper portion of the diaphragm chamber, the steam pressure will be the same above and below the diaphragm, and there will be no force preventing the main spring from pushing down on the valve disc until it is closed, where it will stay closed because of the steam pressure above it.

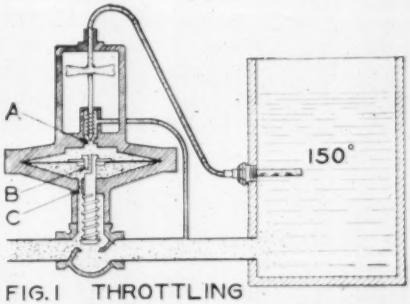


FIG. 1 THROTTLING

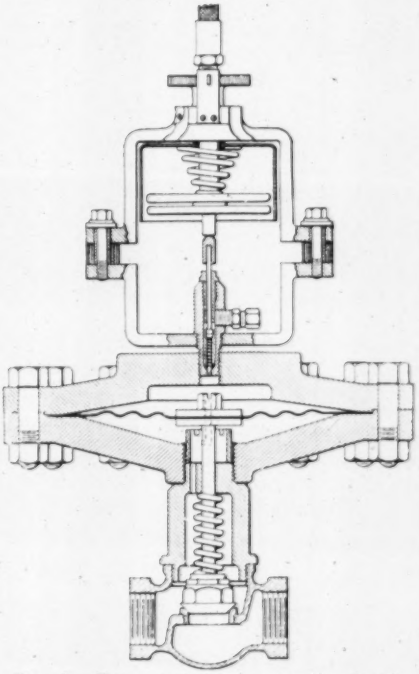


Fig. 2—Cross-section of controller head

If the steam above the diaphragm is allowed to escape through an opening A which is larger than the opening B connecting the spaces above and below the diaphragm, then the pressure above the diaphragm will be less than the pressure below the diaphragm. This differential of pressure will exert an upward force sufficient to open wide the steam valve against the pressure of the main spring.

When the steam is allowed to escape from the upper portion of the diaphragm chamber at approximately the same rate as that at which it passes from below to above the diaphragm, the differential will be just sufficient to counteract the main spring to an extent which will cause the steam valve to be "cracked" to an intermediate extent and will give throttling control.

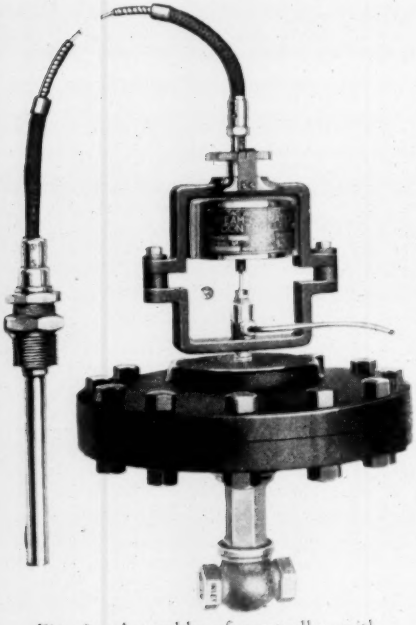


Fig. 3—Assembly of controller with connections

With this general principle in mind it is easy to see that "the opening A through which steam escapes from the upper portion of the diaphragm chamber" is an important opening, since its extent governs the opening, closing, or cracking of the steam valve. Since, in actual size, it is a tiny orifice, a pilot valve placed there requires an insignificant amount of force for its operation. This pilot valve is operated by a metallic bellows which forms a part of the usual thermostat system (sensitive bulb, connecting tube and bellows).

Fig. 3 shows the assembly of the controller complete with the thermostat bulb and connecting tube, and Fig. 2 shows a cross-section through the controller head. The controller consists of three principal parts—the control valve of the globe type, diaphragm for operating the valve, and the pilot valve.

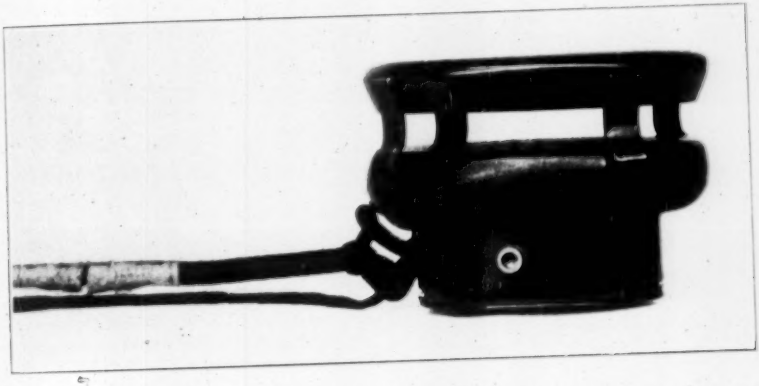
Adjustment of the setting point within the range of the controller is made by means of the knurled dial at the top of the controller head.

The controller is designed to operate on pressures between 5 and 100 lb. and for use as temperature controller is furnished with a 40 deg. range anywhere between the limits of 95 and 290 deg. F. The size of the steam valve ranges in standard pipe sizes all the way from ½ to 4 in.

The Offset Receiver

AN instrument to measure noises has been developed for and is being made by the Western Electric Company. Its uses are varied. They include the measurement of noises in industries where efforts to remedy noisy working conditions are made, where it is desirable to measure the noises arising from manufactured products and generally in any instance where an acoustic examination of factory, office or product is undertaken for corrective or informational purposes. The instrument is also of value to cities and towns in determining the relative amount of noise arising from the use of various types of pavements, street car lines, subways, and the like.

The noise measuring set consists of a portable audiometer and a noise measuring receiver. The audiometer provides a source of energy which may be varied by means of an attenuator in the set. The attenuator is graduated in uniform steps, and covers the range of audibility. The receiver is of the watch case type but differs from the usual unit in that the regular receiver cap is not held against the ear of the listener, but is held away from it by means of a special spacing attachment. This arrangement permits the proper proportion of noise in the room or other locality where the listener is stationed to enter the ear simultaneously with the tone produced in the receiver mechanism by the audiometer.



Through the use of an audiometer it has been discovered that certain inefficiencies on the part of employees which have usually been attributed to dullness or slow thinking are the result of partial deafness. Employers who have adopted the practise of testing prospective workers are preventing those with impaired hearing from being placed in positions dangerous to themselves, from becoming personal hazards

to others, or from becoming subjects of unfair criticism. Going a step further, since there is data at hand as to the effects of noise on the efficiency of workers in general, where acoustic conditions are found to be detrimental, the efficacy of attempts to alleviate the situation are determined by the noise measuring apparatus and proper acoustic treatments thus assured. In determining the amount of noise in any given place, the individual conducting the test arrives at the percentage of loss of hearing in a quiet location and then moves the audiometer close to the noise that is to be measured and again finds the percentage of hearing loss. The difference between the two readings shows the noise standard. For example: if the loss of hearing were 10% under quiet conditions and 40% under noisy conditions, the noise standard would be 30%. The theory of this measurement is explained in the following:

The audiometer furnishes a sustained complex tone to a receiver which is kept a short distance from the ear in order that the noise to be measured may also affect the ear. The intensity of the tone is regulated so that in a quiet place the tone is just barely audible to the observer. Subsequently, the observer obtains a reading when submerged in the noise to be measured, this reading corresponding to the point at which the complex tone is then barely audible. The difference between readings in the quiet and in the noise measures the noise loudness.

Some interesting uses of this instrument have been made, a few of which have received nation-wide publicity. One of the earliest of these was that made by Dr. E. E. Free of New York City who made an acoustic investigation of various street intersections in New York. With the aid of the noise measuring apparatus, he made a scientific fact out of what many New Yorkers had long believed, in setting down Sixth Avenue and 34th Street as the noisiest intersection in the metropolis. He found that Fifth Avenue and 42nd Street ranked next in extent of intensity of noise. More recently, the apparatus has been used to determine the volume of the roar at various points at Niagara Falls.

In industry, the noise measuring apparatus has been successfully used in electric refrigeration factories to determine the amount of noise accompanying the operation of the units manufactured. It has also been used by automobile manufacturers in their efforts to produce quieter motor cars. Other plants where noise measurements prove of value are those manufacturing vacuum cleaners, electric motors, sewing machines, gears, bearings, and the like.

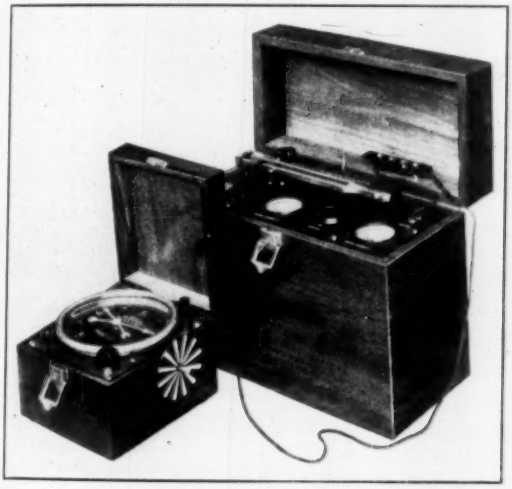
The Synchronometer

General Radio Company

THIS machine is nothing more than an accurately timed automatic transmitting key which, in the model shown in the illustrations, is designed to close a pair of electrical contacts for a brief interval once in every five seconds. It has, however, a special feature in that, while the duration of contact can be adjusted at will to any value between .05 seconds and .50 seconds, the beginning of the contact interval, or in other words, the "nose" of the signal, always occurs exactly at the zero point on the scale.

The complete outfit comprises two instruments: the synchronometer proper and the synchronous driving fork.

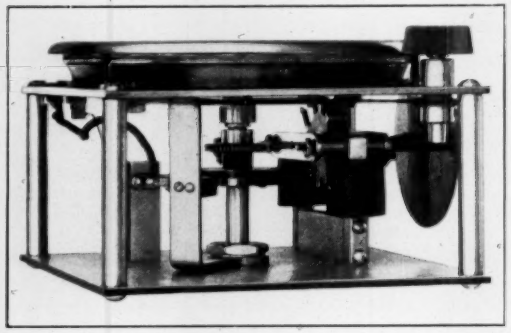
The synchonometer carries a black bakelite dial, the circumference of which is graduated into one-second intervals, each second being, in turn, subdivided into twenty spaces. A clock hand, painted white for clear visibility, sweeps over this dial, keeping exact time when the



The Synchronometer with the Type 467 Synchronous Driving Fork

proper adjustments have been made. The shaft carrying this hand is driven at a uniform speed by a small synchronous motor coupled to the shaft through a 50:1 reduction worm drive. The interior view shows the motor and the driving mechanism. The motor has two poles and a ten-tooth rotor, and hence a synchronous speed of 600 revolutions per minute when driven by 100 pulses of current per second. The extremities of the two field coils terminate in a pair of jacks on the upper panel of the instrument.

An insulating disc bearing an annular metallic segment is mounted upon the vertical shaft carrying the clock arm. Two spring contacts press radically against this segment. One of these is mounted in a fixed position which determines the "nose" of the signal. The second brush is mounted upon an arm which may be swung a certain angular distance around the shaft as a center. This brush determines the instant at which the circuit between both brushes through the revolving segment is interrupted and, hence, the duration of the interval of contact. In the front left hand corner of the upper panel will be seen a thumb screw for swinging this arm and clamping it in any desired position. The two brushes are connected to a second pair of jacks mounted upon



Detail view of Type 473 Synchronometer

the top panel whereby this time interval key may be connected into any desired circuit.

A second identical clock hand, known as the index hand, is mounted directly beneath the motor-driven hand. This index hand, which is normally stationary, is carried by a hollow shaft upon which is mounted, directly beneath the panel, a large grooved pulley. In the front right hand corner of the panel is located a hand knob which carries a small pulley beneath the panel. A belt of twine joins these two pulleys. Thus by manipulating this knob, the index hand may be set at any desired position on the scale.

The purpose of the index hand is as follows:—Suppose that the automatic signal, transmitted at zero time on the scale, sets in motion a train of mechanisms which, at some later time, produces a second signal, preferably audible in nature. The operator, by setting the index hand under the position of the revolving hand at the instant of the retarded signal, can obviously determine the time required for the operation of the mechanism. If this operation can be repeated a few times at five second intervals, a close determination of the elapsed time may be made. Various applications of a device of this sort will suggest themselves. Ob-

viously a slight change in the design of the instrument will permit considerable variation in the time interval between signals.

The interrupted direct current of 100 pulses per second necessary for driving the synchronous motor is supplied by a 100-cycle electrically driven tuning fork. This is mounted in a separate cabinet which carries also ten No. 6 dry cells furnishing six volts for energizing the magnet of the fork and nine volts for operating the motor. Milliammeters are provided for measuring these two currents and a rheostat for controlling the current to the fork magnet. The fork draws about 20 milliamperes and the motor about 200 milliamperes. An adjustable contact is provided upon each tine of the fork, one for interrupting the magnet current to maintain the fork vibrations and the other for controlling the motor current. Both circuits may be opened or closed by a single battery switch. A twin conductor cord fitted with a plug on the synchronometer end joins the two instruments.

The accuracy of the time intervals of the synchronometer is, of course, determined directly by the precision with which the frequency of the fork is adjusted to 100 cycles per second. Small changes in fork frequency can be made by manipulating the rheostat in the driving circuit, while greater changes are accomplished by the adjustment of two counter weights mounted near the outer extremities of the fork tines. A check upon this timing can, of course, be made by comparing the synchronometer with a stop watch. However, if accurately regulated 60 cycle lighting current is available the following procedure is simpler and more rapid. The shaft of the motor protrudes through the right hand side of the cabinet and carries a disc painted black with 12 narrow white segments uniformly spaced around it. When this disc is illuminated by a lighting source supplied with 60 cycle alternating current the spoked pattern will appear stationary if the speed of the motor is exactly 600 R.P.M. If the pattern, on the other hand, appears to advance in the direction of disc rotation, the speed of the motor, and hence the frequency of the fork, is too high and vice versa.

A small knurled handle is attached outside of this disc. This is twirled between the thumb and forefinger to start the motor, which may readily be brought up to synchronous speed by observing the disc pattern in 60-cycle light or by watching the pulses of the needle on the milliammeter reading the motor current.

Readers' Comments

I have been interested in the first number of your New Journal. Thank you for sending us a sample copy.

In connection with Prof. Jaeptner's article on gas-analysis, I wish to call attention to P. W. Swayn's method, presented to the American Society of Mechanical Engineering, Dec., 1916. I have used this simultaneous oxidation method for several years. Swayn's method of calculating results is much simpler, and his choice of volumes gives more accurate results, especially with producer-gas.

It is also not too much arithmetic for careful work to use 20.8% in calculating the oxygen in the air used.

Yours very truly,

S. R. Scholes, Chemist,
Federal Glass Company.
Jan. 25, 1928

I might add that the Williams gas analysis apparatus, with 100 cc explosion burette, is the one I use, and that 1/3 the residue after removing CO_2, O_2 and $C_n H_{2n}$, (30—32cc) is the volume of N_2, CH_4, CO, and H_2 mixed with 50cc air for explosion. The air is let in, 25cc ahead of the gas sample and 25cc behind it, to eliminate error due to capacity of connections.

S. R. S.

———::———

We would like to get about a dozen copies of your January number or reprints of the article by A. A. Grubb, the latter being the only item in which we are interested. Please advise us what these would cost. This is the best article that has been written on the foundry sand situation in our opinion.

Yours truly,

American Colloid Co.,
Paul Bechtner, Vice-President
Jan. 26, 1928

Catalogue Library

Check any of the publications you want. Remove the page and send with coupon to INSTRUMENTS. They will be forwarded to you without cost or obligation.

UNDOUBTEDLY the catalogues of a decade or so ago lived up to the strict dictionary definition "a list of things." Today, however, a catalogue is the result of no small effort and expense on the part of the manufacturer, who sets forth the merits of his product in such a manner that the public is made to recognize all its good points. Details of manufacture and operation of the instrument are given in considerable detail. It is a learned mind, indeed, that cannot derive some information from this type of literature. As a matter of fact, few books can be purchased where the information contained therein is more up-to-date than that found in the average catalogue.

In this section will be listed each month the new catalogues published during that time by the various instrument companies, who place such information at the disposal of the editor. Only such catalogues or bulletins should be requested as will be of direct interest to the individual making the request. When the catalogue or bulletin is received it should be carefully filed or afforded the protective accommodation of a book shelf. It will then be available for ready reference at all times and avoid a request for duplicate copies.

Automatic Controller

Bulletin No. 900A of the C. J. Tagliabue Mfg. Co., 18 33d Street, Brooklyn, N. Y., covers Automatic controllers for temperature, pressure, humidity, time, condensation and liquid level. This is an exceptionally fine catalog. The introduction discusses the importance of control in the various industries. The principle of the Tag Air-Operated Automatic Controllers is very thoroughly covered. The whole catalog is well illustrated.

Automatic Steam-Operated Controller

The Tag Automatic Steam-Operated Controller is the title of Catalogue No. 950 recently issued by the C. J. Tagliabue Mfg. Co. 18 Thirty-third St., Brooklyn, N. Y. This controller is simply a device which utilizes a portion of the steam which heats an apparatus to obtain enough power to work the valve, the opening and closing of which governs the temperature.

Automatic Temperature Control

Wilson-Maculen Company, Inc., 383 Concord Ave., New York, N. Y., have recently issued a booklet entitled An Introductory Outline of Automatic Temperature Control as Applied to Industrial Furnaces. They state this is a discussion, not a catalog.

Bailey Boiler Meters

Are illustrated and described in detail in Bulletins Nos. 43 and 43-A, published by the Bailey Meter Company, Cleveland, Ohio. Principles of combustion in furnaces, together with fuel and furnace conditions are taken up. The means by which losses may be detected are given. A number of charts, illustrating the relations between the various quantities measured, are shown in 43-A.

Data Concerning Platinum

A book recently received from Baker & Co., Inc., Murray and Austin Streets, Newark, N. J., illustrates the various platinum ware manufactured by them. A Historical Summary of Platinum, Occurrence of Platinum Ore, The Platinum Metals and Uses of Platinum, its Allied Metals and Alloys are some of the Chapter headings.

Direct Reading Hammer-Fennel Tacheometer

Catalogue No. 125E of Otto Fennel Sons, 16 Koenigstor, Kassel, Germany, is entitled "The Direct Reading Hammer-Fennel Tachometer 1927 Model and the Hammer-Fennel Topometer."

Flow Indicators

Morey, Jones & Lovell, 922 So. Hemlock St., Los Angeles, Calif., have issued Bulletin 203, covering the M-J-L Flow Indicators for the accurate measurement of the flow of gas or liquids under all conditions.

Glass Instruments

Prospeckt No. 118 of Christ. Kob & Co., Stuetzerbach in Thueringen, Germany, shows the general line of glass ware manufactured by them.

Hand Tachoscope

Price Sheet No. 502, issued by Herman H. Sticht & Co., 15 Park Row, New York, N. Y., briefly describes The Standco Hand Tachoscope—a Revolution Counter and Stop Watch. The applications and advantages are listed.

Hardness Testing

The First Method of Hardness Testing that has been found adaptable to practically Universal Use is the title of a booklet just issued by Wilson-Maculen Company, Inc., 383 Concord Ave., New York, N. Y.

Hasler Speed Indicator

The Hasler Tel Co., 461 Eighth Avenue, New York, N. Y., in a recent bulletin describe their speed indicator, its construction, operation, use, application, care, upkeep and salient features.

Herschel Emulsifier

A recent leaflet published by The American

Instrument Co., 1220 D Street, Northwest, Washington, D. C. is entitled The Herschel Emulsifier—Its use in testing resistance of oil to Emulsification.

Manometers and Thermometers

A leaflet of Rosenthal & Schaede, Ritterstrasse 59, Berlin S W 68, Germany, illustrates the low pressure steam manometers, heating thermometers and boiler lever gauge.

Measuring Gas Density

Measuring Gas Density with Ranadex Recorders is the title of a leaflet issued by The Permutit Company, 440 Fourth Avenue, New York, N. Y. It describes an instrument which operates on the same principle as their CO_2 Indicator and Recorder.

Mecury Relay

The American Instrument Co., 1220 D Street, Northwest, Washington, D. C., have issued a leaflet covering the Aminco Mecury Relay, a device for opening and closing electrical circuits.

Metastatic Thermoregulator

Bulletin No. 910 of the American Instrument Company, 1220 D Street, Northwest, Washington, D. C., describes the Metastatic Thermoregulator for accurately controlling the temperature of constant temperature apparatus.

Multi-Pointer Gages for Draft

The Bailey Meter Company of Cleveland, Ohio, has issued Bulletin No. 162 which illustrates and describes very thoroughly the Multi-pointer draft gages manufactured by them. Gages are available for low, medium and high pressure units. Differential draft and pressure units are also shown, as well as signals and interlocks.

Pocket Microscope

The Busch pocket microscope is described in a recent leaflet of The Palo Co., 155 West 23d Street, New York, N. Y.

Recording Thermometer

The Bristol Company, Waterbury, Conn., have issued a leaflet, entitled "It Has Arrived," in which they announce their new Model recording thermometer using a 4-inch chart.

Recording Wattmeters and Frequency Meters

A new catalog, 1502 Wattmeter Section, has just been issued by The Bristol Company, Waterbury, Conn. This catalog describes both the Round Chart and Strip Chart Recording Wattmeters. Wiring diagrams illustrating the connections into the circuit are also given. In addition this catalog takes up Recording Frequency Meters and Instrument Transformers.

Slide Rules, Drawing Instruments, Planimeters

A leaflet issued by E. Heckendorff, Berlin SO 36, Germany, illustrates and describes their drawing tables and instruments, precision and special slide rules, precision polar slide rule, and compensation planimeter.

Sligh Oxidation Bath

The Aminco Sligh Oxidation Bath, manufactured by the American Instrument Company, 1220 D Street, Northwest, Washington, D. C., is described in their bulletin No. 125. The bath is equipped with the Metastatic Thermoregulator, which is set to hold a constant temperature of 200° C. and the thermal characteristics of the bath are so regulated that this temperature is easily maintained well within the allowable tolerance.

Telefault

A recent bulletin of the W. M. Matthews Corporation, 3710 Forest Park, St. Louis, Mo., is entitled Type L Matthews Woodpecker Telefault. The instrument will indicate all cable troubles, excepting "open."

Thermometers, Hydrometers, Barometers

Catalogue 21 issued by the A. E. Moeller Co., 261 Sumpter Street, Brooklyn, N. Y. illustrates the products manufactured by them.

Time Recorder

The New Esterline—Angus Time Recorder is described in Bulletin 1127 recently issued by The Esterline Angus Company, Indianapolis, Ind. The various applications of the instrument are discussed in detail: Recording Tests of Truck Drivers; Recording Promptness of calls in Hospitals; Headway Recorders for Street Railways; Use in Power Plants; Recording Direction of Wind; Use in Automatic Sub-Stations, Use on Street Lighting Circuits; Use by Telephone Companies; Time Records in Steel Plants; Records in Glass Plants; In Cement Manufacture; In Concrete Making; In Paper Mill and Printing Plants; and Recording the Speed of Railway Trains.

Water Determination Apparatus

Christ. Kob & Co., Stuetzerbach in Thuringen, Germany, have issued a leaflet "Kleiner selbsttaetiger Wasserbestimmungsapparat" describing an instrument for the determination of water by the distillation method using specific light auxiliary liquids as Toluol, Benzol, etc.

Watt-hour Meter Calibrating Machine

Hans Boas, Berlin O 27, Krautstrasse 38a/39, Germany, had issued Druckschrift No. 609 entitled Zaehler-Eichmaschine, Type F. This machine serves as the current source for the calibration of meters and instruments.

SEND COUPON FOR LITERATURE DESIRED

INSTRUMENTS PUBLISHING CO., 1117 Wolfendale St., Pittsburgh, Pa.

Please send us, without obligation, the literature checked herewith.

Company .....

Name ..... *Title* .....

Address .....

Review of Recent Patents

Printed copies may be obtained at the cost of 10 cents by addressing the Commissioner of Patents, Washington, D. C.

REFRIGERATOR CONTROL MECHANISM. William Erick Behl, Chicago, Ill., assignor to Iron Mountain Co. Pat. No. 1,654,523.

TIME STAMP. Cornelius B. Corcoran, Phoenix, Ariz., assignor to Underwood Typewriter Co. Pat. No. 1,654,532.

METER. Thomas Ralph Goldsmith, Erie, Pa., assignor to American Meter Co., Inc. Pat. No. 1,654,541.

ORIFICE PLATE. Jacob M. Spitzglass, Chicago, Ill., assignor to Republic Flow Meters Co. Pat. No. 1,654,559.

WAVE DEVIATION METER. Lewis W. Chubb, Edgewood, Pa., assignor to Westinghouse Electric & Mfg. Co. Pat. No. 1,654,576.

CONTROL VALVE. Joy S. Reynolds, San Francisco, Calif., assignor, by direct and mesne assignment, of one-half to Joy S. Reynolds, Detroit, Mich., and one-half to Charles A. Balcolm, San Francisco, Calif. Pat. No. 1,654,602.

SCALE. Walter F. Stimpson, Louisville, Ky. Pat. No. 1,654,620.

RECORDING SYSTEM. Frederick Carleton Bisbee, Chawford, N. J., assignor to American Telephone & Telegraph Co. Pat. No. 1,654,633.

TRIFOCAL OPTICAL LENS. Paul Echlev, Walnut Creek, Calif. Pat. No. 1,654,641.

ELECTROMAGNETIC FUEL-CONTROL VALVE. Harry G. Geissinger, Detroit, Mich. Pat. No. 1,654,642.

RECORDING SYSTEM. Irving Walter Green, Crawford, N. J., assignor to American Telephone & Telegraph Co. Pat. No. 1,654,645.

ELECTROMAGNETIC CONTACTOR. William G. Hartwig, Chicago, Ill., assignor to E. J. Magerstadt. Pat. No. 1,654,646.

WEIGHING SCALE. Halvor O. Hern, Toledo, Ohio, assignor to Toledo Scale Co. Pat. No. 1,654,648.

MAXIMUM-DEMAND METER. Frederick C. Holtz, Springfield, Ill., assignor to Sangamo Electric Co. Pat. No. 1,654,730.

METHOD OF AND APPARATUS FOR DETECTING BINDING POINTS IN WELL CASINGS. Myron M. Kinsley, Tulsa, Okla. Pat. No. 1,654,819.

TEMPERATURE-INDICATING DEVICE. Roger C. Lafite, Liberty, Mo. Pat. No. 1,654,822.

MICROMETER CALIPER. Earl C. Sparks, Crauston, R. I., assignor Brown & Sharp. Pat. No. 1,654,843.

LIQUID MEASURING DEVICE. Archibald Franklin Anderson, Galt, Ontario, Canada. Pat. No. 1,654,853.

ADJUSTABLE ELECTRICAL CONDENSER RESISTANCE, VARIOMETER AND THE LIKE. Claude Gustaf Hjalmar de La Val, Stockholm, Sweden. Pat. No. 1,654,867.

VARIABLE CONDENSER. Benjamin Q. Isler, New York, N. Y., assignor by mesne assignment to Lazarus Shapiro. Pat. No. 1,654,881.

MEASURING SYRINGE. Frederick A. Voos, Newark, N. J., assignor to Western Electric Co., Inc. Pat. No. 1,654,905.

REGULATION OF ELECTRIC DISTRIBUTION SYSTEMS. Henry de Bovne Knight, Rugby, England, assignor to General Electric Co. Pat. No. 1,654,917.

REGULATOR. Louis W. Thompson, Schenectady, N. Y., assignor to General Electric Co. Pat. No. 1,654,948.

CURRENT-REGULATING ARRANGEMENT FOR RECTIFIERS. Pierre Marie Gabriel, Toulon, France, assignor by mesne assignment to General Electric Co. Pat. No. 1,654,949.

PENDULUM LEVEL. Hubert Crumbach, and Herbert C. Maxwell, Cleveland, O. Pat. No. 1,654,964.

REGULATION FOR ELECTRIC DISTRIBUTION SYSTEMS. Henry deB Knight, Rugby, England, assignor to General Electric Co. Pat. No. 1,654,979.

REGULATOR. Albert H. Mittag, Schenectady, N. Y., assignor to General Electric Co. Pat. No. 1,654,987.

REGULATOR OF ELECTRICAL CURRENT. Albert H. Mittag, Schenectady, N. Y., assignor to General Electric Co. Pat. No. 1,654,988.

POWER-CONTROL APPARATUS. Albert H. Mittag, Schenectady, N. Y., assignor to General Electric Co. Pat. No. 1,654,989.

ELECTRICAL CONDENSER. Greenleaf Whittier Pickard, Newton Center, Mass., assignor to Wireless Specialty Apparatus Co. Pat. No. 1,655,022.

REGULATING APPARATUS. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Co. Pat. No. 1,655,041.

STATOR-PLATE ADJUSTMENT FOR VARIABLE CONDENSERS. Ernst Ross, East Orange, N. Y., assignor by mesne assignment to Radio Condenser Co. Pat. No. 1,655,109.

PROTECTED THERMOMETRIC ELECTRIC-CIRCUIT CLOSER. Elbert B. Wilson, East Orange, N. J., assignor to Gold Car Heating & Lighting Co. Pat. No. 1,655,119.

INSIDE MICROMETER GAUGE. Charles A. Clark, Portland, Oregon. Pat. No. 1,655,133.

REGULATOR. Ragnar Carlstedt, Stockholm, Sweden, assignor to Arca Regulators, Inc. Pat. No. 1,655,219.

PROTECTIVE RELAY FOR SERIES RELEASES. Wilhelm Henning Peterson, Ludvika, Sweden, assignor to Allmanna Svenska Elektriska Aktiebolaget. Pat. No. 1,655,237.

HEIGHT GAUGE. Alexander Priputnevich, Hawtramck, Mich. Pat. No. 1,655,239.

TELEMETRIC SUMMATION SYSTEM. Ralph M. Rowell, Lynn, Mass., assignor to General Electric Co. Pat. No. 1,655,244.

GYROSCOPIC NAVIGATIONAL APPARATUS. Peter Schilovsky, London, Eng. Pat. No. 1,655,247.

ELECTRIC MEASURING SYSTEM. Geza Lichtschneindl, Belgrad, Serbia, assignor to General Electric Co. Pat. No. 1,655,276.

REGULATOR. Albert W. Hull, Schenectady, N. Y., assignor to General Electric Co. Pat. No. 1,655,389.

ELECTRIC CURRENT REGULATOR. Charlton Stanford Agate and Albert Edward Hill, Chelmsford, England, assignors to Radio Corp. of America. Pat. No. 1,655,451.

KILOVOLT-AMPERE DEMAND METER. Henry J. Blakeslee, West Hartford, Conn. Pat. No. 1,655,492.

ELECTRICITY METER. Jesse Harris, La Fayette, Ind., assignor to Duncan Electric Manufacturing Co. Pat. No. 1,655,604.

RECORDING & TIMING DEVICE FOR COMBUSTION ENGINES. Paul Kreisel, Newark, N. J. Pat. No. 1,655,615.

GAS METER. Geo. A. Lane, Chicago, Ill. Pat. No. 1,655,654.

MAGNETIC TEMPERATURE REGULATOR. Arthur Herman Adams, La Grange, Ill., assignor to Western Electric Company, Inc. Pat. No. 1,655,852.

OVEN HEAT REGULATOR. Benj. E. Meacham, Lorain, Ohio, assignor to American Store Co. Pat. No. 1,656,010.

ELECTRICAL MEASURING INSTRUMENT. Raymond T. Pierce, East Pittsburgh, Pa., assignor to Westinghouse Electric & Mfg. Co. Pat. No. 1,656,013.

ELECTRICAL MEASURING INSTRUMENT. Walter E. Hull, Sharpsville, Pa. Pat. No. 1,656,116.

WIRELESS APPARATUS FOR DETERMINING ANGLES OR DIRECTION. Guy du Bourg de Bozas, Paris, France. Pat. No. 1,656,147.

Jesse C. Fishel, Brooklyn, N. Y. Pat. No. 1,656,262.

SCALE. Robert Craig, Dayton, Ohio, assignor to Dayton Scale Co. Pat. No. 1,656,267.

TESTING MACHINE FOR THREADED MEMBERS. Earle Buckingham, Hartford, Conn., assignor to Pratt & Whitney Co. Pat. No. 1,656,314.

INDICATOR. Edmund Batchelder, New York, N. Y., assignor of one-half to

TANK GAUGE. George R. Gould, Kansas City, Mo. Pat. No. 1,656,705.

TESTING DEVICE FOR ELECTRIC WIRING SYSTEMS. Solomon B. Berkowitch, Baltimore, Md. Pat. No. 1,656,768.

CIRCUIT BREAKER. Harry F. Smith, Dayton, Ohio, assignor to The Gas Research Company. Pat. No. 1,656,837.

DETONATION INDICATOR. Samuel P. Morley, Pittsburgh, Pa., and William A. Gruse, Wilkinsburg, Pa., assignor to Gulf Refining Company. Pat. No. 1,656,879.

TESTING & SORTING MACHINE. Byron B. Goldsmith, New York, N. Y., George A. Spiegelberg, executor of said Byron B. Goldsmith, deceased. Pat. No. 1,656,887.

MICROMETER GAUGE. Ernest O. Wheelock, Rockford, Ill. Pat. No. 1,656,927.

PRESSURE GAUGE. Roy D. St. John, Spokane, Wash. Pat. No. 1,657,047.

INTERMITTENTLY-OPERATING ELECTRIC REGULATOR. Arle Ytterberg, Ludvika, and Aage Gardc, Vasteras, Sweden, assignors to Allmanna Svenska Elektriska Aktiebolaget. Pat. No. 1,657,056.

TEMPERATURE-CONTROLLING SYSTEM. Alfred W. Burke, Long Island City, N. Y. Pat. No. 1,657,065.

CURRENT-FLOW INDICATOR. Christian Berger, New York, N. Y. Pat. No. 1,657,103.

TENSIOMETER. George Arthur Iler, Youngstown, Ohio. Pat. No. 1,657,261.

TEMPERATURE INDICATOR. William J. Francke, New Brunswick, N. J. Pat. No. 1,657,353.

PRESSURE REGULATING DEVICE. Frederick F. Bahnson, Winston-Salem, N. C. Pat. No. 1,657,362.

DEFLATION INDICATOR. James F. McGuire, Kittanning, Pa. Pat. No. 1,657,406.

CANADIAN PATENTS

All copies of specifications and drawings attached to Canadian Patents are certified and are furnished to the public by Patent and Copyright Office, Ottawa, Ont., at the following rates:

For every single or first folio (100 words)	$0.25
For every subsequent hundred words (fractions thereof under fifty not being counted, and over fifty being counted for one hundred)	0.10
For every copy of drawings, per sheet	0.25
For every additional copy of drawings, per sheet	0.15

Remittances must be in current bankable funds, bank drafts, money orders, or certified cheques. Money sent by mail should be registered letters and is at the risk of the sender. Drafts, money orders and cheques should be made payable to the Commissioner of Patents, Ottawa.

APPARATUS FOR TESTING BURSTING STRAINS. Walter A. Johnson, Olean, N. Y., and Rudlif Hueckler, Three Rivers, Mich. Pat. No. 276,717.

RECORDING DEVICE FOR METERS. Stanley Thomas Lewis, Regina, Saskatchewan, Canada. Pat. No. 276,764.

VARIABLE CONDENSER. Warren Reese, Brackenridge, Pa. Pat. No. 276,948.

GAS METER. Giorgis Mangiaracina, Brooklyn, N. Y. Pat. No. 276,948.

TEMPERATURE DEVICE. Harold T. Fans, Lynn, Mass., assignor to Canadian General Electric Co., Ltd. Pat. No. 277,013.

SPEED REGULATOR. Charles A. Hoxie, Schenectady, N. Y., assignor to Canadian General Electric Co., Ltd. Pat. No. 277,015.

CIRCUIT INTERRUPTING DEVICE. John A. Spencer, Revere, Mass., assignor to The Spencer Thermostat Co. Pat. No. 277,058.

TEMPERATURE CONTROL DEVICE. Albert H. Simmons, Wheaton, Ill., assignor to Canadian General Electric Co., Ltd. Pat. No. 277,166.

TORSION BALANCE. Herman Shaw, Barnes, County of London, and Ernest Lancaster Jones, Maidenhead, County of Berkshire, both in England, assignors to The Geophysical Research Corporation, New York. Pat. No. 277,176.

PHOTO AMPLIFYING SYSTEM. Richard H. Ranger, Newark, N. J., assignor to The Radio Corporation of America. Pat. No. 277,202.

VARIATION OF QUANTITY OR POSITION INDICATOR. Erick Pearson, Columbia Heights, Minn. Pat. No. 277,293.

BRITISH PATENTS

ELECTRIC METERS. Sangamo Electric Co., Springfield, Ill. Pat. No. 280,494.

INDICATING APPARATUS. W. Wermeilho, Neuchatel, Switzerland. Pat. No. 280,507.

COLORIMETERS. C. Zeiss, Jana, Germany. Pat. No. 280,552.

ELECTRIC MEASUREMENTS. Siemens-Schuckertwerke, A. G., Berlin, Germany. Pat. No. 280,564.

HYGROMETRIC APPARATUS. American Moistening Co., Providence, R. I. Pat. No. 280,821.

FLUID METERS. P. H. and F. M. Roots Co., Connersville, Ind. Pat. No. 280,854.

TESTING VISCOSITY OF LIQUIDS. Zellstofffabrik Waldhof and R. Haas, Baden-Baden, Germany. Pat. No. 280,876.

REGULATING FLUID FLOW. Soc. Anon. Solex, Neuilly-sur-Seine, France. Pat. No. 280,879.

DIVIDERS FOR MEASURING LENGTH. J. Durdis, Moravia, Czecho-Slovakia. Pat. No. 280,898.

ELECTRIC MEASUREMENTS. Siemens-Schuckertwerke, A. G., Berlin, Germany. Pat. No. 280,911.

WEIGHING APPARATUS. Maatschappij, Tot Vervaardiging van Snijmachines Volgens van Berkel's Patent en van Andere Werktuigen, Rotterdam, Holland. Pat. No. 280,943.

LIQUID METERS. Liquid Measurements, Ltd., and F. Hammond, London, England. Pat. No. 281,015.

GAS METERS. J. S. Wilson and Glover & Co., London, England. Pat. No. 281,101.

AIR SPEED INDICATORS FOR AIRCRAFT. G. Mengden, Paris, France. Pat. No. 281,116.

ELECTRIC MEASUREMENTS. L. A. Paine, Toronto, Canada. Pat. No. 281,188.

SLIDING CALLIPER GAUGES. M. A. Bord, Pontarlier, France. Pat. Nos. 281,202 and 281,203.

ELECTRIC METERS, ETC. British Thomson Houston Co., Ltd., London, England. Pat. No. 281,250.

THERMOMETERS. Electroflo Meters Co., Ltd., London, England. Pat. No. 281,341.

TIME RECORDERS. E. E. Symonds, Walton-on-Thames, England. Pat. No. 281,368.

LIQUID-LEVEL INDICATORS. R. Elms, Peterborough, England. Pat. No. 281,450.

WEIGHING APPARATUS. W. & T. Avery, Ltd., Birmingham, England. Pat. No. 281,468.

GAS METERS. A. M. Knauer, J. Elster, L. Goez, E. Hasswerichelt and P. Haas, Mainz, Germany. Pat. No. 281,667.

You can't hope to enjoy the harvest without first sowing the seed. You can't expect to pluck the fruits from effort if that effort is not displayed. There is no time like the present—especially if the other fellow is inclined to wait.

ADVERTISE NOW—A FEW JUMPS AHEAD OF THE FELLOW WHO IS INCLINED TO WAIT.

Current Literature Review

Abstracts on instruments of interest to instrument readers

Comparison of Methods of Measuring Knock Characteristics of Fuels. Graham Edgar, Jl. S.A.E. Jan. 1928, pp. 41-48.

Considerable divergencies are reported in the results obtained by different methods, particularly for certain fuels, although there is reasonable agreement for other fuels. No system of rating the knock characteristics of fuels is in use at present by which the results of different laboratories are readily comparable. An analysis of the data obtained from the nine laboratories is given, and possible reasons for the divergencies are discussed.

In his general discussion of the results, the author points out that two distinct problems are involved in the data. The first is the rating of fuels in terms of the quantity of tetracthyl lead needed to make the fuels equal to a standard better than they are. The second problem is the rating of the fuels themselves in terms of some other standard fuel to which an antiknock or benzol has been added, or in some arbitrary system.

Tensile Working Stress for Rivets Investigated. C. R. Young. Engg. News-Rec. Feb. 2, 1928, pp. 188-190.

Abstract from a paper presented at the annual convention of the American Institute of Steel Construction. Tests were made for pure tension and for combined stresses. Lack of initial tension in shafts is shown.

A New Method for the Calibration of Ammeters at Radio Frequencies. Herbert C. Hazel. Proc. Inst. Radio Engrs. Jan. 1928, pp. 70-74.

This paper describes the construction and operation of a thermionic vacuum tube which is designed for the measurement of radio frequency currents. The input circuit consists of a filament whose cross-section is small enough that the "skin effect" is negligible at the frequencies used. The filament is heated first by currents of known magnitude (at a low frequency) and again by radio-frequency currents to be measured. Electrons emitted by the heated filament are drawn to an anode sealed into the tube and a comparison of the resulting space currents indicates, if the necessary precautions are taken, the amount of current in the input circuit.

The Hall High-Speed Recorder. E. M. Tingley. Jl. A.I.E.E. Jan. 1928, pp.7-11.

A new form of oscillograph for recording fault currents and their voltage disturbing effects in electric power systems is described. The instrument is a form of oscillograph for tracing continuously the maximum values of current and voltage during system fault conditions. Its sturdy construction makes it suitable for application in generating stations and sub-stations. It seems to be the only instrument yet developed for this class of service. Its performance lies between that of the standard oscillographs and the switchboard curve-drawing meters with speed-up attachments.

Representative records are analyzed and further applications of the instrument are suggested.

The Measurements of Air Quantities and Energy Losses in Mine Entries. Part II Alfred C. Callen and Cloyde M. Smith. Bull. No. 170. Engg. Exp. Sta., University of Illinois.

Air quantities were determined by the method of subsectional velocity-pressure measurements developed in previous work. As a result of the investigation the following conclusions were drawn: 1. Experience in measuring mean velocities ranging from 350 to 1900 feet per minute in mine entries of different degrees of uniformity, confirms conclusions described in Bulletin 158; 2. An increase in the number of subsections in a given cross-section gives mean-velocity results somewhat lower than are obtained with a smaller number of subsections; 3. The "center constant," or ratio mean velocity to center velocity for a given cross-section, is primarily a function of the section itself, including its shape and the

characteristics of the entry, and varies but slightly with velocity change; 4. If extreme care is used a center constant, correct within one or two per cent, may be obtained for a given cross-section by making two or three traverses for a given condition of air flow; 5. Results obtained by anemometer transversing indicate that while a certain degree of accuracy can be had by calibrating the anemometer against pitot-tube traverses at a given cross-section, yet the anemometer data are less consistent than the pitot tube data, the average residuals for the former being twice as great as for the latter; 6. The kata thermometer was tried as an instrument for determining velocities in direct comparison with the pitot tube. The results obtained were erratic; 7. Simultaneous readings on the Ellison and Wahlen gage throughout complete traverses gave good agreement between mean velocities computed from these data; 8. Expression for energy loss, derived from Atkinson formula, shows energy loss varies as cube of velocity; 9. Magnitude of the energy losses under different entry conditions is shown; 10. Value of k in Atkinson formula calculated on assumption that pressure losses vary as the square of the velocity; 11. Pressure losses due to bends, the inner radius being about 12 feet, expressed as a function of the velocity pressure, expressed as a function of the velocity pressure were about 1.0 velocity at one bend and about 0.5 velocity pressure at another; 12. Attention called to fact that k is not a coefficient of friction alone but a factor covering all energy losses of whatever nature, particularly those losses caused by extraordinary turbulence.

A New Gyroscopic Stabilizer. Comptes Rendus. Jan. 16, 1928, pp. 128.

The useful reaction exerted upon the hull by a gyroscopic stabilizer depends at each instant on the speed and angular position of the equipment taking part in the precessions. It is necessary to submit this equipment to a system of links capable of assuring the development of precessions in a large measure as possible and of producing a certain gyroscopic reaction of the equipment towards the point at which the axis of the rotating mass is perpendicular to that of rolling. It is this system of links which determine the practical value of an anti-rolling apparatus.

In the Sperry stabilizer the movements of the gyroscope relative to the hull are determined by an auxiliary mechanism at a practically constant speed, depending upon the indications of an element sensitive to alternations in the direction of rolling.

Other methods have been proposed for assuring a material variation in the speed of precession, so as to give to the useful gyroscopic reaction the direction of the thrust of the wave upon the hull, but their realization has always appeared difficult.

In the stabilizer described in this note, the author proposes to obtain, solely by the play of passive forces, to the exclusion of all elastic action, either of the counterpoise or of the sensitive element: 1. The effect of repulsion of the mobile equipment towards the mean position; 2. A pseudo-movement of the stabilizing or damping couple; 3. A suitable limitation of the amplitude of precession; 4. The almost total suppression of lag between the disturbing action of the wave and the reaction of the gyroscopic element, i.e., the four essential conditions for correct functioning, assuring a maximum of efficiency. This apparatus comprises two gyroscopes having opposing precessions coupled by the agency of toothed sectors, forming a system practically insensible to the effects of pitching and of gyration.

The results given indicate how one may take advantage of the material precession to obtain anti-rolling mechanisms which will behave reliably and which are very simple.—O. W. E.

Gyroscopic Compasses Employed on Board Vessels and Airships. Guy Ralgorn. Genie Civil. Jan. 9, 1928, pp. 37.

An article dealing with the principles underlying the gyroscope and describing the most important types of gyrocompass.

1. The Anchuetz mono-gyroscopic and tri-gyroscopic compasses.
2. The Sperry compass.

Some space is given to a description of the damping mechanisms employed in these gyroscopes and also in the Brown compass.—O. W. E.

SPECIAL SERVICE FOR SUBSCRIBERS

SUBSCRIBERS Service Section of INSTRUMENTS is operated to give quickly, reliably and at a minimum expense the following service:

1. **Complete copies of articles covered in the Abstract Section**
2. **Translations of foreign articles covered in the Abstract Section**
3. **Lists of references to books and articles on any instrument, method of testing, measurement, etc.**

INSTRUMENTS makes the entire field of literature on instruments and their application and use available to every subscriber; distance is eliminated, for it will copy the desired information and send it to you. It also assists the busy man by supplying information without any expenditure of his time. The charge for this personal work is merely its cost.

The Subscribers Service Section of INSTRUMENTS does not obtain any profit from the work, but does this to make the information contained in our library and the large libraries with which it has connection available to every subscriber. The rates are as follows:

Photo Print Copies of articles, drawings, etc., 35c per 10x14 sheet plus cost of mailing

Searches, etc., $2.00 an hour

Translation, $10.00 per thousand words for French or German; $15.00 and upwards for other languages

INSTRUMENTS PUBLISHING CO.

1117 WOLFENDALE ST., PITTSBURGH, PA.

Automatic Control Applied to the Small Stoker. Ind. Power. Jan. 1928, pp. 57-59.

Gives the results of a pioneer installation at the Grand Laundry, Chicago. —Q. M.

Why Guess at Temperatures of Objects? Ind. Power. Jan. 1928, pp. 62-63.

Describes Pyrometer Instrument Company's optical and radiation pyrometers. —Q. M.

Tension Testing as Applied to Steel Castings. Research Group News. Jan. 1928, pp. 164-171.

The precautions to be considered are listed. The casting of test coupons is also thoroughly discussed.—C. W. K.

Equipment for Making Physical Tests. Heat Treating and Forging. Jan. 1928, pp. 38-40.

The impact testing and microscopic examination of steel are taken up.—C.W.K.

The T. B. C. Photo Colorimeter. Paper Ind. Jan. 1928, pp. 1702-1703.

A translation from Bulletin de la Societe d' Encouragement pour l'Industrie Nationale, June 1927, pp. 421-430. The instrument is described in detail.—L. E. B.

Instruments and Flow Meter Equipment. Power Pl. Engg. Jan. 15, 1928, pp. 120-125.

Describes the refinements, made during the past year by the various flow meter manufacturers, which increase the accuracy and application of the instruments.—Q. M.

Indicating and Recording Electric Meters. Power Pl. Engg. Jan. 15, 1928, pp. 134-138.

Describes several developments of new types of meters.—Q. M.

Combustion and Furnace Control. Douglas Henderson. Power Pl. Engg. Jan. 1, 1928, pp. 3-6.

The importance of executive control for steam generation from the selection of the fuel to the delivery of the steam, is taken up. It is pointed out that the boiler requires continuous supervision. The value of records in the growing plant is given.—Q. M.

Suitability of Fuels Determined by Tests. Power Pl. Engg. Jan. 1, 1928, pp. 6-10.

Methods of conducting fuel analyses applicable to every day power plant operation are given. The methods of sampling and the proximate analysis of coal (oxygen bomb calorimeter, sodium peroxide bomb calorimeter, oxygen bomb calorimeter fitted with adiabatic jacket) together with the necessary calculations are shown. Calorimeters for gas and ash tests are briefly discussed.—Q. M.

Fuel Record Checks Plant Performance. Power Pl. Engg. Jan. 1, 1928, pp. 10-13.

The instruments, for obtaining records of fuel used in power plants, are briefly described and illustrated.—Q. M.

Determination of Air Supplied to Furnace. Power Pl. Engg. Jan. 1, 1928, pp. 13-14.

The importance of combustion air measurement for maintaining efficiency is briefly shown. The several types of air flow meters are mentioned as the displacement types, pitot tubes, anemometers, orifices, nozzle and electric air flow meters.—Q. M.

Furnace Operation Shown by Draft Measurement. Power Pl. Engg. Jan. 1, 1928, pp. 15-18.

This article states that fuel bed conditions, excess air leakage, variations in load, fallen baffles and soot accumulation give characteristic readings on draft gages. Illustrations show the gages of some of the draft gage manufacturers.—Q. M.

Gas Measurements that Indicate Efficiency. Power Pl. Engg. Jan. 1, 1928, pp. 19-23.

The instruments for the measurement of temperature and gas analysis are briefly illustrated and described. Under the instruments for temperature measurement shown are thermocouples, thermostat thermometers, resistance thermometers, Leeds & Northrup optical pyrometer, and Thwing radition pyrometer. Under gas analysis instruments are shown: the Orsat apparatus, Republic CO_2 recorder, Bacharach Electric CO_2 meter and the Ranarex CO_2 meter.—Q. M.

THIS publication is copyrighted. Permission will be granted for reprints from INSTRUMENTS on condition that the full title of the article, name of author, page reference, and date of publication are given.

It is hoped that all who are interested in the use of instruments will assist the periodical to achieve its purpose by contributing original papers, notes, etc., dealing with the particular subjects which engage their attention. Authors alone are responsible for statements made and opinions expressed in their respective articles.

An author is entitled to 25 copies of the issue of INSTRUMENTS containing his article.

Rate of subscription throughout the United States of America $2.00 per year; $5.00 elsewhere, payable in advance. Send subscriptions to Circulation Department, Instruments Publishing Company, 1117 Wolfendale Street, N. S., Pittsburgh, Pa.

INSTRUMENTS PUBLISHING CO.

Condensate Handling Presents Many Problems. Power Pl. Engg. Jan. 1, 1928, pp. 62-64.

This article takes up volumetric meters and V-notch meters for measuring condensate; recording thermometers for temperature measurement; and the electrolytic conductance leakage meter.—Q. M.

Circulating Water Supply Extremely Important. Power Pl. Engg. Jan. 1, 1928, pp. 64-66.

The effect of temperature of circulating water on operation of the boiler plant is taken up.—Q. M.

Machinability of Metals. Orlan W. Boston. Trans. A.S.S.T. Jan. 1928, pp. 59-94, 154.

The paper gives an outline of the various methods which are being used to designate the machinability of metals, and gives under the heading of each method an outline of the work done by various authors as published in a few outstanding papers on the subject. Machinability may refer to the relative machining qualities of several metals under the same conditions or to those of a given metal under varying conditions.

Several methods discussed which have been used to indicate machinability are as follows:

1. The measurement of the force on a tool to cut a metal under standardized conditions.

2. The measurement of the force or energy required to remove a given chip under standardized conditions.

3. The ability of a standardized tool to cut various metals, in terms of tool life or cutting speed.

4. The measurement of the finish left on the cut surface.

5. The penetration of a standardized drill when cutting at constant speed and under given load.

6. The torque developed by a drill while drilling various metals under standardized conditions.

7. A cutting speed for a certain tool life under standardized conditions expressed in terms of physical properties of the material being cut.

8. The hardness numbers of the materials as indicated by a hardness testing machine.

9. The measurement of heat generated and the hardness induced by the cutting process.—C. W. K.

A Cheap and Accurate Metal Scale for Scientific Instruments. David Crowther and J. J. Willaman. Ind. Engg. Chem. Jan. 1928, pp. 30-31.

An ink drawing is made two or three times as large as the desired scale. The drawing is sent to the print shop with instructions as to exact size of the reproduced scale. A "positive" zinc etching is made. The characters stand out in relief, accuracy of original is maintained and the scale is durable.—M. E. H.

Carbon Monoxide Recorders. S. H. Katz and H. W. Frevert. Ind. Engg. Chem. Jan. 1928, pp. 32-34.

The principle of operation is 1) the reaction $2CO + O_2 = 2CO_2 + 67960$ g. cal. per g. mol. CO, promoted by hopcalite catalyst; 2) the heat liberated affects a series of thermocouples; 3) a recording potentiometer, calibrated in terms of CO as parts per 10,000 of air-gas mixture, gives the results. A picture and a diagram are given. The latter shows the operations clearly. A motor-driven blower takes in the gas and forces its successively through a H_2SO_4 wash, a canister containing activated C, alkaline granules and cotton, thence to a flowmeter, $CaCl_2$ tube and finally to coils and cell immersed in steam bath, and through guard tube to waste.

A detailed diagram of the cell is also given. The cell consists of two compartments, the lower one containing the constant temperature (100 deg. C.) junctions imbedded in pumice stone, the upper one containing the thermocouples imbedded in hopcalite. In the latter the CO is oxidized and the differential temperature effect produces the potentials recorded.—M. E. H.

Methods of Hardness Testing. Amer. Mach. Feb. 2, 1928, p. 231.

Table and charts showing comparison of Rockwell and Brinnel Readings. Information compiled by the Wilson-Maeulen Company.

Buyers' Guide

Instruments and accessories used for measurement, inspection or control in the industries and sciences.

If you are unable to find what you require in the Buying Section of Instruments—Industrial and Scientific, fill in the form below and we will obtain full particulars for you without charge. Give complete information of requirements.

ALIDADES
Otto Fennel Sons

AMMETERS
Indicating
Hoyt Electrical Instrument Works
Rawson Electrical Instrument Company
Recording
Bristol Company

ANEMOMETERS
Colonial Supply Company
B. K. Elliott Company

BAROMETERS
Aneroid, Mercurial, Recording
Colonial Supply Company
B. K. Elliott Company

CARBON DIOXIDE METERS
Bacharach Industrial Instrument Co.
Tagliabue Mfg. Co., C. J.

CARBON MONOXIDE METERS
Bacharach Industrial Instrument Co.
Tagliabue Mfg. Co., C. J.

COLORIMETERS
Tagliabue Mfg. Co., C. J.

COMPASSES
Otto Fennel Sons

CONTROLS, AUTOMATIC
Float
American Radiator Company
Motor
American Radiator Company
Pressure & Vacuum
American Radiator Company
Bristol Company
Tagliabue Mfg. Co., C. J.
Pyrometer
Bacharach Industrial Instrument Co.
Bristol Company
Wilson-Maculen Company, Inc.
Refrigeration
American Radiator Company
Temperature
American Radiator Company
Automatic Electric Heater Company
Bacharach Industrial Instrument Co.
Bristol Company
Tagliabue Mfg. Co., C. J.
Wilson-Maculen Company, Inc.
Thermometer
Bristol Company
Tagliabue Mfg. Co., C. J.
Wilson-Maculen Company, Inc.
Thermostat
American Radiator Company
Automatic Electric Heater Company
Bristol Company
Unit Heater
American Radiator Company
Valve—Motor Operated
American Radiator Company
Bristol Company
Water Level
American Radiator Company
Bristol Company

COUNTERS
Revolution
Adde Company
Stroke
Adde Company

DEMAND METERS—see Meters

DRAFT GAUGES—see Gauges

ENGINE INDICATORS
Bacharach Industrial Instrument Co.

FLASH POINT TESTERS
Tagliabue Mfg. Co., C. J.

FLOW METERS—see Meters

FLUXMETERS
Rawson Electrical Instrument Co.

FREQUENCY METERS
Recording
Bristol Company

GAS ANALYTICAL METERS
Chemical
Tagliabue Mfg. Co., C. J.
Electric
Bacharach Industrial Instrument Co.
Hydrogen
Bacharach Industrial Instrument Co.
Portable
Bacharach Industrial Instrument Co.
Sulphur Dioxide
Bacharach Industrial Instrument Co.

GAUGES
Indicating
Draft
Bacharach Industrial Instrument Co.
Bristol Company
Water Level for Boilers
Bristol Company
Rain
B. K. Elliott Company
Recording
Distance
Bristol Company
Draft
Bacharach Industrial Instrument Co.
Bristol Company
Pressure & Vacuum
Bacharach Industrial Instrument Co.
Bristol Company
Colonial Supply Company
Tagliabue Mfg. Co., C. J.
Water Level for Boilers
Bristol Company

The Compressibility of Sand-Mica Mixtures. Glennon Gilboy. Proc. A.S.C.E. Feb. 1928, pp. 555-568.

The experiments show that the presence of the flat mica grains has a marked effect on the compressibility of the mixture under load, on its expansion after release of pressure, and on the limiting voids ratios consistent with equilibrium. Inasmuch as a direct determination of the exact quantity of flat grains in a soil is a practical impossibility, one is at once lead to the conclusion that analysis and classification of soils can be of value only when based on observations of the physical characteristics of the soil as a mass, as well as the behavior of the soil under stress.

A Warpage Study of Terra Cotta Clays. R. M. Murphy. Jl. Amer. Ceram. Soc. Feb. 1928, pp. 103-104.

Several types of clays which compose a commercial terra cotta body, were studied for warpage during drying and firing. Results of warpage test show other properties that each clay gives to the terra cotta body.

Strength of Brick in Tension. J. W. McBurney. Jl. Amer. Ceram. Soc. Feb. 1928, pp. 114-119.

A self-aligning grip for use in testing brick in tension is described. Values for the tensile strength of several types of brick are given. Comparison is made between the transverse and tensile strength of the brick. The conclusion is that the tensile strength is closely related to the transverse strength.

Motion Pictures Visualize Structure and Stress of Steel. Harold A. Knight. Ir. Tr. Rev. Feb. 2, 1928, pp. 324-325.

The application of the motion picture camera aided by the microscope, the X-ray, fluoroscope, telephoto lens is briefly described.

Further Studies on Portland Cement Compounds by the X-Ray Diffraction Method. W. C. Hanson. Jl. Amer. Ceram. Soc. Feb. 1928, pp. 68-78.

In this investigation a study has been made of methods for preparing compounds of CaO with Al_2O_3 and SiO_2 which may occur in Portland cements. The products from the different methods were studied microscopically and by the X-ray diffraction method and the X-ray diffraction patterns for gamma and beta 2 CaO . SiO_2 and 3 CaO . SiO_2 are given.

Notes on a Method for Determination of Workability of Plastic Clays. Samuel J. McDowell. Jl. Amer. Ceram. Soc. Feb. 1928, pp. 99-102.

A factory control test is described for determining the point at which workable plasticity is developed.

Automatic Control of Electric Furnaces. L. G. Bean. Elect. Light. Feb. 1928, pp. 64-70, 91.

The article takes up the various controllers: liquid or gas filled thermometer controllers; millivoltmeter or depressor bar pyrometers; potentiometers; resistance thermometers and bi-metallic expansion thermometers.

Ground Detection. John Auchincloss. G. E. Rev. Feb. 1928, pp. 76-81.

The various methods for ground detection for the various types of commercial circuits are taken up: 125 volt DC two-wire ungrounded circuit; Edison three-wire (ungrounded neutral) systems; two-phase systems and three-phase three-wire circuits.

Daylight Recording by Means of the Photo-electric Cell. L. R. Koller. G. E. Rev. Feb. 1928, pp. 85-86.

The variations in the intensity of daylight are measured by means of a photo-electric cell and recorded. Typical records are given and explained.

Daylight Measurement by Means of the Visual Photometer. Frank Benford. G. E. Rev. Feb. 1928, pp. 87-88.

The measurement of light intensity with the ordinary or visual photometer presents difficulties that lead the author to make favorable reference to the possibilities of the photo-electric cell photometer.

Inspection Devices in the Westinghouse Plant. William H. Miller. Machinery Feb. 1928, pp. 409-412.

Takes up a number of gages and gigs used for inspection of parts.

The 30-inch Reflecting Telescope and Photoelectric Photometer of the University of Illinois Observatory. Robert H. Baker. Pop. Ast. Feb. 1928, pp. 86-91.

A description of the telescope and the photometer are given.

HARDNESS TESTERS
Pittsburgh Instrument & Machine Co.
Wilson-Maculen Company, Inc.

HUMIDITY RECORDERS
Wet & Dry Bulb Thermometers
Bristol Company
Tagliabue Mfg. Co., C. J.

HYDROMETERS
Tagliabue Mfg. Co., C. J.

HYGROMETERS
Colonial Supply Company

IMPACT TESTING MACHINES
Alternating
Pittsburgh Instrument & Machine Co.

LEVELS
Engineer's, Wye, Precision
B. K. Elliott Company
Otto Fennel Sons
Pittsburgh Instrument & Machine Co.

MANOMETERS
Bacharach Industrial Instrument Co.

MEGOHMMETERS
Herman H. Sticht and Company

METERS
Demand
Gas
Bacharach Industrial Instrument Co.
Flow
Gas & Air
Bacharach Industrial Instrument Co.
Lineal Measuring
Adde Company
Pressure
Bacharach Industrial Instrument Co.

MICROAMMETERS
Rawson Electrical Instrument Company
Wilson-Maculen Company, Inc.

MICROMETERS
Colonial Supply Company

MICROSCOPES
Brinell
Pittsburgh Instrument & Machine Co.
Metallographic
E. Leitz, Inc.
Petrographical
E. Leitz, Inc.

MILLIAMMETERS
Hoyt Electrical Instrument Works
Rawson Electrical Instrument Company
Wilson-Maculen Company, Inc.

MILLIVOLTMETERS
Bristol Company
Hoyt Electrical Instrument Works
Rawson Electrical Instrument Company
Wilson-Maculen Company, Inc.

MOTION RECORDERS
Mechanical
Bristol Company

OHM METERS
Rawson Electrical Instrument Company
Herman H. Sticht and Company

OIL TESTING APPARATUS
Tagliabue Mfg. Co., C. J.

OPERATION RECORDERS
Electrical
Bristol Company

PLANIMETERS
Radial
Bristol Company

POSITION RECORDERS
Bacharach Industrial Instrument Co.

PRESSURE METERS—see Meters

PSYCHROMETER
Recording
Tagliabue Mfg. Co., C. J.
Sling
Colonial Supply Company

PYROMETERS
Optical
Bacharach Industrial Instrument Co.
Pyrometer Instrument Company
Radiation
Indicating
Bacharach Industrial Instrument Co.
Colonial Supply Company
Pyrometer Instrument Company
Recording
Bacharach Industrial Instrument Co.
Thermo-electric
Immersion
Bacharach Industrial Instrument Co.
Bristol Company
Pyrometer Instrument Company
Wilson-Maculen Company, Inc.
Indicating
Bacharach Industrial Instrument Co.
Bristol Company
Wilson-Maculen Company, Inc.
Recording
Bacharach Industrial Instrument Co.
Bristol Company
Wilson-Maculen Company, Inc.
Surface Contact
Bristol Company

SHEET METAL TESTERS
Pittsburgh Instrument & Machine Co.

SPECIAL ELECTRICAL INSTRUMENTS
Rawson Electrical Instrument Company

STEEL TAPES
Colonial Supply Company
Otto Fennel Sons
Pittsburgh Instrument & Machine Co.

TACHOMETERS
Bristol Company
Colonial Supply Company
Pyrometer Instrument Company
Herman H. Sticht and Company

THEODOLITES
Otto Fennel Sons
Pittsburgh Instrument & Machine Co.

THERMO-JUNCTIONS (Electric)
Rawson Electrical Instrument Company

THERMOMETERS
Gas Filled
Indicating and Recording
Bristol Company
Colonial Supply Company
Tagliabue Mfg. Co., C. J.
Mercurial
B. K. Elliott Company
Tagliabue Mfg. Co., C. J.
Resistance
Indicating
Wilson-Maculen Company, Inc.
Recording
Wilson-Maculen Company, Inc.

Measurement and Regulation of Feed Water. Power Pl. Engg. Jan. 1, 1928, pp. 32-33.

Briefly mentions various types of water meters.—Q. M.

Measuring and Controlling Boiler Pressure. Power Pl. Engg. Jan. 1, 1928, pp. 35-38.

This article shows the indicating and recording steam pressure gages, methods of testing and calibrating them: Safety valves and their capacities and methods of testing.—Q. M.

Determination of Boiler Water Level. Power Pl. Engg. Jan. 1, 1928, pp. 38-41.

Use and care of water column gage glasses, rules for installation, types of remote-boiler water level indicators, typical records of water level indicators, typical records of water level recorders and discussion of their meaning are some of the subjects considered.—Q. M.

Temperature of Steam is an Important Factor. Power Pl. Engg. Jan. 1, 1928, pp. 41-45.

The various types of mercury thermometers, gas-filled and vapor-tension thermometers, thermocouples and resistance thermometers are illustrated. The determination of moisture in steam by calorimeters is discussed.—Q. M.

Measuring and Recording the Flow of Steam. Power Pl. Engg. Jan. 1, 1928, pp. 46-49.

The principles of operation of flow meters, are given and the various primary elements are illustrated. Some of the flow meters available on the market today are illustrated by diagrams.—Q. M.

Control of the Boiler as a Unit. Power Pl. Engg. Jan. 1, 1928, pp. 50-52.

Various types of automatic devices for controlling the operation of the boiler are described and illustrated by means of cross-sectional diagrams.—Q. M.

Measurements on Steam Engines and Turbines. Power Pl. Engg. Jan. 1, 1928, pp. 52-54.

The following is taken up: determination of pounds of steam per kilowatt hour: per indicated horsepower hour: use of the engine indicator: tests by weighing the condensed steam and the use of Dynamometers.

Air and Steam Measurements most Difficult. Power Pl. Engg. Jan. 1, 1928, pp. 59-62.

The use of instruments, showing the air and steam conditions in the condenser are taken up in this article. The various instruments considered are: the mecury column vacuum gage, indicating and recording vacuum gages mecury column barometer, aneroid barometer, absolute pressure gage, mecury thermometer, indicating and recording thermometers, indicating and recording pyrometers, gasometer and air meters.—Q. M.

On the Extension of Lubricants on Solid Surfaces (De l'extension des Lubrificants sur les surfaces solides). Paul Woog. Comptes Rendus. Jan. 9, 1928, pp. 71-73.

A description of tests designed to determine the value of various oils as lubricants at temperatures up to about 100 degrees C. "It is possible, if the above results are to be relied upon, and if variations in viscosity are neglected, to maintain from the lowest temperatures up to 100 degrees C. oils capable of lubricating chronometers or other apparatus."—O. W. E.

Lamp-Room Photometer. J. S. Haldane and R. V. Wheeler. Coll. Guard. Jan. 20, 1928, pp. 233-234.

The photometer used is of simple, strong, and inexpensive design, its object being to furnish a ready means by which the actual lighting efficiencies of lamps in actual use can be tested both before and after a shift whenever tests are desired.

The Measurement of Low Air Velocities in Mines. J. P. Rees. Coll. Guard. Jan. 20, 1928, pp. 233-234.

Instruments for the measurement of low air velocities at the mine working faces taken up, with special reference to the torsion anemometer.

Power and Heating Accounting. C. C. Hermann. Ind. Power. Jan. 1928, pp. 41-44, 82.

This article stresses the importance of metering the steam at the boilers and also at the various departments in the plant. The readings are then to be entered on a form headed "Distribution of Steam" which makes available an accurate knowledge of the cost of power.—Q. M.

THERMOSTATS
American Radiator Company
Automatic Electric Heater Company
Bristol Company

TRANSITS
Engineer's, Surveyors, Mine
B. K. Elliott Company
Otto Fennel Sons
Pittsburgh Instrument & Machine Co.

VISCOSIMETERS
Tagliabue Mfg. Co., C. J.

VOLTMETERS
Indicating
Hoyt Electrical Instrument Works
Rawson Electrical Instrument Company
Recording
Bristol Company

WATTMETERS
Indicating
Rawson Electrical Instrument Company
Recording
Bristol Company

Instruments Is a New Periodical With a Wide Field of Usefulness

EVERY article appearing in INSTRUMENTS begins on the right hand page, the pages are numbered consecutively and side wire stitched. This makes it possible for each reader to build up a technical record of the articles in the form best adapted to the needs of the reader:

1. All issues of the journal can be collected and bound into an annual volume.
2. The technical information appearing during the year can be assembled according to subjects.
3. The single articles may be assembled in loose leaf note-books, binders or in filing jackets or in any manner desired by the reader.

In addition to the regular table of contents, there is a 3x5 file card section carrying the title, author, volume, number of issue, and date and pages on which all original articles may be found. These are bound in the back of each issue and when cut out and filed give ready access to important instrument information, which the reader may be searching for at some future time.

INSTRUMENTS is indispensable for

The OPERATING MAN, for reference purposes or to increase his technical knowledge;

The SPECIALIST, who must follow all the developments in instruments in his special field;

The INVESTIGATOR and SCIENTIST, who desire to follow the developments in instruments outside their own field;

ROUTINE and RESEARCH LABORATORIES, who desire information on instruments.

The Testing Materials Laboratory of an up-to-date Machinery Plant Based on the Experience Gained at the Materials Exposition 1927. (Die Materialpruefstelle einer zeitgemaessen Maschinenfabrik nach den Erfahrungen der Werkstoffshau 1927) M. Kurrein. Werkstättstechnik. Jan. 15, 1928, pp. 20-24.

Briefly illustrates and describes the testing machines exhibited at the Exposition.

Use of Radio-electrical Methods for Geophysical Measurements. (Sur un procede de visee radioelectrique applicable a la Geodesie.) M. P. Schwartz. Comptes Rendus. Jan. 9, 1928, pp. 73. (Complete translation below.)

I have made, by means of a very sensitive receiving apparatus, but without a divided circle, radio-electric observations upon stations situated some at a short distance and others at a great distance. I have been able, by progressively diminishing the temperature of the lamps, to determine the azemuth of the station. I estimate the precision obtained to be comparable to that of optical observations and I preconceive two modes of observation: the first consists in observing directly the base by bringing the sound to the minimum audible again: the second on the contrary in determining the observations of the audible limits of the base to the right and left, with an audition of the least force. A radiogoniometer, specially constructed for this purpose, allows of the application to the observations of the method of series and of obtaining results comparable with those obtained in actual service.—O. W. E.

Testing Insulation with High Frequency. J. L. Rylander. Elect. Jl. Jan. 1928. pp. 10-13.

The method of test described here gives a comparative simple, yet remarkably thorough means of determining insulation conditions.

Oscillography—VIII Auxiliary Apparatus for Staged Tests with the Multi-element Oscilligraph. Joseph W. Legg. Elect. Jl. Jan. 1928, pp. 39-46.

Various attachments for the oscillograph are mentioned: the simultaneous viewing attachment; galvanometer elements; external resistor; adjustable noninductive shunt; driving head; shutter mechanism; remote control and cut-out switches.

BUYERS' INQUIRY FORM

INSTRUMENTS—*Industrial and Scientific*
1117 Wolfendale St.,
Pittsburgh, Pennsylvania.

GENTLEMEN:—

Please furnish information on the following:

NAME

ADDRESS

COMPANY

POSITION

On the following pages are standard file cards, which the editor believes will be a valuable asset to you personally. These cards will be bound in each issue of Instruments and will cover the original articles contained in that issue. The color of the card and ink to be used is shown here. This will facilitate distinguishing the INSTRUMENTS FILE CARDS from others with which they might be consolidated.

The editor suggests that these cards be carefully cut out immediately on receipt of INSTRUMENTS and filed in your desk or in a file box on top of your desk. You will then have within easy reach an index of instrument information of incalculable value.

The card is arranged with a space for classification subject or number at the top. Suggestions as to classifications for the cards are:

HISTORY OF VOLTA
HARDNESS MEASUREMENT

———::———

Time lost can never be regained. Putting off YOUR ADVERTISING until tomorrow means a loss of business during the period that could be used to make TODAY A BRIGHTER AND BETTER DAY.

ADVERTISE NOW—MAKE EVERY DAY A BRIGHTER AND BETTER DAY.

———::———

Advertisers Index

	Page
A	
Adde & Company, Portland, Maine	8
American Radiator Co., 816-820 S. Michigan Ave., Chicago, Ill.	1
Automatic Electric Heater, 1505 Race Street, Philadelphia, Pa.	9
B	
Bacharach Industrial Instrument Co., 7008 Bennett St., Pittsburgh, Pa.	4
Bristol Co., The, Waterbury, Conn.	Inside Back Cover
C	
Colonial Supply Co., 217 Water Street, Pittsburgh, Pa.	3
E	
Elliott Co., B. K., 127 Sixth Street, Pittsburgh, Pa.	10
F	
Fennel Sons, Otto, Kassel, 85, Germany	8
H	
Hoyt Electrical Instrument Works, 857 Boylston St., Boston, Mass.	8
L	
Leitz, Inc., E., 60 East Tenth Street, New York, N. Y.	9
P	
Pittsburgh Instrument & Mach. Co., 1026 Reedsdale St., Pittsburgh, Pa.	8
Pittsburgh Piping & Equipment Co., 43rd St. and A.V.R.R., Pittsburgh, Pa.	Back Cover
Pyrometer Instrument Co., 74A Reade St., New York, N. Y.	5-9
R	
Rawson Electrical Instrument Co., 90-92 Windsor St., Cambridge, Mass.	6
S	
Sticht & Co., Herman H., 21 Park Row, New York, N. Y.	7
T	
Tagliabue Mfg. Co., C. J., 18 to 88 Thirty-third St., Brooklyn, N. Y.,	Inside Front Cover
W	
Wilson-Maeulen Co., Inc., 18 Concord Ave., New York, N. Y.	12

CUT OUT THESE CARDS AND PLACE IN YOUR FILE

INSTRUMENT PIONEERS—ALESSANDRO VOLTA (1745-1827)

INSTRUMENTS, Vol. 1, No. 2, Feb. 1928, pp. 83-86.

The life of Volta is given in this short article as it was abridged from "Electrical Communication."

○

COMPARISON OF THE VARIOUS METHODS OF TESTING THE HARDNESS OF METALS

D. L. **MATHIAS.** INSTRUMENTS, Vol. 1, No. 2, Feb. 1928, pp. 87-91.

The article is a brief survey of the subject. The advantages of hardness tests are given: 1. Wide applicability; 2. Ease and rapidity; 3. Special test pieces unnecessary; 4. Finished work may be tested without fear of damage; 5. Permit drawing conclusions in regard to some of the other physical properties.

The various methods taken up are: Brinell hardness, Rockwell hardness, scleroscope hardness, scratch test.

Comparative merits of the methods are briefly mentioned.

○

INSTRUMENTS FOR THE MEASUREMENT OF ELECTRICAL INSULATION

A. **WATSON.** INSTRUMENTS, Vol. 1, No. 2, Feb. 1928, pp. 93-98, 6 figs.

The properties of insulators are listed and briefly defined: Dielectric Strength, Dielectric Capacity, Surface Leakage, and Leakage through the material itself.

Diagrams show the arrangement of the instruments for making the various tests with the different current sources.

(*Continued in the March Issue.*)

○

CUT OUT THESE CARDS AND PLACE IN YOUR FILE

CUT OUT THESE CARDS AND PLACE IN YOUR FILE.

CUT OUT THESE CARDS AND PLACE IN YOUR FILE.

MEASURING TO FOUR PARTS IN A BILLION

P. P. **CIOFFI.** INSTRUMENTS, Vol. 1, No. 2, Feb. 1928, pp. 99-104, 2 figs.

The apparatus and method of measurement in detecting changes of length of permalloy with magnetization is described.

THE NEW IMPROVED TYPE OF BRADY B.T.U. INDICATOR

R. A. **MALONY.** INSTRUMENTS, Vol. 1, No. 2, Feb. 1928, pp. 105-109, 4 figs.

The use of the indicator is briefly mentioned. The description of the instrument as well as its operation are given. The method of calibrating the indicator concludes the article.

THE MEASUREMENT OF LUSTER

DR. W. **EWALD.** INSTRUMENTS, Vol. 1, No. 2, Feb. 1928, pp. 111-113, 1 fig.

The status of the measurement of luster is briefly reviewed. The difficulties connected with the conversion of the luster values obtained with the various instruments is shown. An instrument is then described which the author believes overcomes these difficulties. In conclusion a definition of luster value is given.

BRISTOL'S

Recording Liquid Level Gauges

For automatically recording the depth of water in tanks, reservoirs, rivers, irrigation systems, sewage disposal systems, etc.; also the rate of flow of water over weirs, in tail races, etc.

Operation Not Affected By Low Temperatures

In operation the instrument is really a pressure gauge using an air filled system. The sensitive bulb is mounted on a plank or other support, and lowered into the water, the level of which is to be measured. A suitable length of capillary tubing connects the bulb to the recording instrument, which may be mounted at any convenient location either above or below the bulb level. As air is the transmitting medium there is no danger of freezing, and in fact, the operation of the instrument is not affected by any ordinary temperatures. The instrument can be calibrated to read in terms of feet, inches, volume or other units of measurement.

This type gauge is very flexible in its application, and is used to measure and record not only water level, but also depth and volume of other liquids in storage. If desired Bristol's Automatic Alarm attachment can be used with Liquid Level Gauge equipment—to sound warning bell should levels exceed or go below definite limits.

Write for Literature.

The Most Complete Line

of Recording and Control equipment including: Pressure, Pressure Control; Liquid Level; Temperature; Temperature Control; Electricity, Speed, Motion, Humidity, etc. Write for catalogs.

The Bristol Company

Waterbury, Connecticut

Branch Offices

Boston Philadelphia Birmingham Chicago Denver
New York Pittsburgh Detroit St. Louis San Francisco